

THE HYDRO-ELECTRIC POWER COMMISSION
OF ONTARIO

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RULES

AND

REGULATIONS

GOVERNING

Electrical Installations

and

Equipment

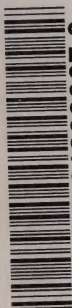
ELEVENTH EDITION

1939



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THE POWER COMMISSION ACT

Revised Statutes of Ontario, 1937

Chapter 62—and Amendments thereto—

Regulations
as to.—

87.—(1) The Commission may, with the approval of the Lieutenant-Governor in Council, make rules and regulations:—

Construction
of works, etc.

(a) prescribing the design, construction, installation, protection, use, maintenance, repair, extension, alteration, connection and disconnection of all works and matters used or to be used in the generation, transformation, transmission, distribution, delivery or use of electrical power or energy in Ontario;

Use of
works until
authorized

(b) prohibiting the use in Ontario of any such works or matters until they shall have been inspected and approved;

Advertising or
sale of works in
unauthorized
manner.

(c) prohibiting the advertising, display, offering for sale, or other disposal, and the sale or other disposal, publicly or privately, in Ontario, of any such works or matters unless and until they shall have been inspected and approved, and prescribing the precautions to be taken in the sale or other disposal of such works or matters and the warnings and instructions to be given to purchasers and others in advertisements and by circular or otherwise in order to prevent their use in such manner or under such conditions as may be likely to result in undue hazard to persons or property;

Inspection,
test and
approval.

(d) providing for the inspection, test and approval of all such works and matters before being used for any such purposes.

Issuing of
plans and
specifications.

(2) The Commission may prepare and issue plans and specifications governing the design, construction and test of any of the works or matters mentioned in subsection 1, and may amend or alter such plans and specifications.

Orders relating
to installations,
alterations, etc.

(3) The Commission may issue such orders relating to work to be done in the installation, removal, alteration, repair, protection, connec-

tion or disconnection of any of the works or matters mentioned in subsection 1 as the Commission may deem necessary for the safety of the public, or of workmen, or for the protection of property.

Appointment of inspectorial staff.

(4) The Commission may appoint such inspectors and other officers as it may deem necessary for the purposes of this section.

Fees for permits, inspection, test and approval.

(5) The Commission may prescribe the fees to be paid for permits and for inspection, test and approval of all such works and matters mentioned in subsection 1 and of plans and specifications relating thereto, and may prescribe also the time and manner of payment of such fees.

Collection and disposition of fees and fines.

(6) The Commission shall collect the fees prescribed by it under the authority of subsection 5, and shall provide for the remuneration, travelling and other expenses of the said inspectors and other qualified persons, together with all other expenses incurred in carrying out the provisions of this section, out of the said fees and out of any fines imposed for breach of any of the provisions of this section or of any rules, regulations, plans, specifications or orders made under the authority thereof, and out of the funds appropriated for carrying out the work of the Commission.

Powers of inspectors.

(7) Every inspector appointed under the authority of this section may, at any reasonable hour, enter upon, pass over or through any land, building or premises for the purpose of performing the duties assigned to him under the authority of this section.

Liability.

(8) Nothing in this Act or in any of the rules or regulations, plans, specifications or orders issued under the authority of this section shall render the Commission or any of its inspectors or other employees liable, or shall affect the liability of any municipal or other corporation or commission, company, firm or individual, for any injury, loss or other damages caused to any person or property by reason of defects in any of the works or matters mentioned in this section or by reason of any order of the Commission,

notwithstanding any inspection or test or the issue of any certificate by the Commission or by any of its inspectors or other employees.

Penalties

(9) Every municipal or other corporation or commission, and every company, firm or individual,—

For interference;

(a) hindering, molesting, disturbing or interfering with an inspector or other employee in the performance of his duty under this section shall incur a penalty of not less than \$10 or more than \$50 for each offence;

For disobedience to regulations;

(b) refusing or neglecting to comply with the provisions of this section, or with any rule or regulation, plan or specification made under the authority thereof, shall incur a penalty of not less than \$10 or more than \$50 for each offence;

For disobedience to order.

(c) refusing or neglecting to comply with any order issued by the Commission under the authority of subsection 3 shall incur a penalty of not less than \$100 or more than \$500 and a further penalty of not less than \$100 or more than \$500 for each and every separate day upon which such refusal or neglect is repeated or continued.

Recovery of penalties

(10) The penalties imposed by or under the authority of this section shall be recoverable under *The Summary Convictions Act* and shall be paid over to the Commission.

Rev. Stat., c.136.

Section not to apply to mines.

(11) This section shall not apply to any mine as defined under *The Mining Act*, save only as regards any dwelling house or other building not connected with or required for mining operations or purposes or used for the treatment of ore or mineral. R.S.O. 1927, C.57, s.80.

Rev. Stat., c.47.

Proving regulations as to installations, etc.

(12) The regulations passed pursuant to this section may be approved by the production of a copy of such rules and regulations certified to by the Secretary and bearing the seal of the Commission and the production of such certified copy bearing the seal of the Commission shall be *prima facie* evidence of the due execution thereof by the said Secretary. 1931, c.13, s.6.

ONTARIO

EXECUTIVE COUNCIL OFFICE

Copy of an Order-in-Council approved by the Honourable, the Lieutenant-Governor, dated the 29th day of February, A.D., 1940.

Upon the recommendation of the Honourable W. L. Houck, Member of the Executive Council, and upon the application of The Hydro-Electric Power Commission of Ontario, the Committee of Council advise that under and by virtue of The Power Commission Act, R.S.O. 1937, Cap. 62, approval be given to the amendments made by the said Commission to its Rules and Regulations governing electrical installations and equipment, and also to the said Rules and Regulations so amended, all as contained in the attached book entitled "Rules and Regulations Governing Electrical Installations and Equipment, Eleventh Edition, 1939", including therein the Canadian Electrical Code, Part I, Fourth Edition, of the Canadian Engineering Standards Association.

Certified,

(Sgd.) H. A. STEWART,

Assistant Clerk, Executive Council.

RULES AND REGULATIONS GOVERNING ELECTRICAL INSTALLATIONS AND EQUIPMENT

1. The Hydro-Electric Power Commission of Ontario, under and by virtue of the authority vested in it by The Power Commission Act, R.S.O. 1937, Chapter 62, and Amendments thereto, and with the approval of the Lieutenant-Governor in Council, hereby makes the following Rules and Regulations Governing Electrical Installations and Equipment, namely,—(i) the General Regulations and Schedules of Inspection and other Fees hereinafter set forth; and (ii) publication "C.22.1-1939" of the Canadian Engineering Standards Association, known as the "Canadian Electrical Code, Part I", which is hereby adopted by the said Commission for use in the Province of Ontario.

GENERAL REGULATIONS

2. In the administration and enforcement of these Rules and Regulations the Commission may act either directly or through any inspector.

INTERPRETATION

3. In these Rules and Regulations, notwithstanding anything to the contrary contained in that part thereof known as the "Canadian Electrical Code, Part I"—

- (a) "Approved" shall mean with reference to any electrical equipment that the use, sale, offer for sale, or other disposal of such equipment in Ontario has been authorized by the Commission;
- (b) "Accepted" shall mean with reference to any electrical equipment that it has been deemed by the Commission to be outside a regular line of manufacture or to be of any other type or character requiring procedure other than would be involved in having it approved; that it has been specially inspected or tested by the Commission and complies with the specifications and other requirements of the Commission concerning it; and that the use, sale, offer for sale, or other disposal of such equipment in Ontario has therefore been authorized by the Commission;
- (c) "Approval Label" shall mean a metal plate, a transfer or a paper sticker permanently affixed to approved electrical equipment and indicating that it has been approved;

- (d) "Commission" shall mean The Hydro-Electric Power Commission of Ontario;
- (e) "Contractor" shall mean any person, corporation, company, firm, organization or partnership performing or engaging to perform either for his or its own use or benefit, or for that of another, and with or without remuneration or gain, any electrical work or installation within the scope of these Rules and Regulations;
- (f) "Dispose of" shall mean sell, lease, rent, lend, give, or otherwise transfer title, ownership or possession;
- (g) "Attempt to dispose of" shall mean advertise, display, offer for sale or make any other attempt to dispose of;
- (h) "Electrical Equipment" shall mean any equipment, machinery, apparatus, appliance, instrument, device, fitting or material designed for, used in, or intended to be used in the generation, transformation, transmission, distribution, supply or utilization of electric energy;
- (i) "Inspection Department" shall mean the Commission;
- (j) "Inspector" shall mean any officer, servant or agent appointed by the Commission for the purposes of these Rules and Regulations;
- (k) "Person" shall mean any firm, corporation, company, partnership, organization or individual;
- (l) "Service Agreement" shall mean an agreement in a form satisfactory to the Commission and covering the re-examination, periodic examination or test, and labelling of approved electrical equipment, or any of these matters;
- (m) "Specifications" shall include the publication of the Canadian Engineering Standards Association, known as the "Canadian Electrical Code, Part II", and amendments thereto, in so far as such publication may from time to time be adopted by the Commission for use in Ontario;
- (n) "Supply Authority" shall mean the Commission or any other corporation, company, commission, firm, organization or person supplying electric energy;
- (o) "Armoured Cable", "Building", "Permit", "Service Box" and "Special Permission" shall have the meanings assigned to them in the definitions contained in that part of these Rules and Regulations known as the Canadian Electrical Code, Part I.

ELECTRICAL EQUIPMENT

4. All electrical equipment within the scope of these Rules and Regulations shall be either approved or accepted, and if required by service agreement to bear an approval label, shall be so labelled.

5. All approved electrical equipment which by Rule 4 hereof is required to bear an approval label shall be so labelled, otherwise it shall be deemed to be not approved.

6. No person shall affix to any electrical equipment any approval label other than one which is supplied by or is otherwise acceptable to the Commission.

7. No person shall affix any approval label to any electrical equipment other than that for which such approval label was issued, and then only if such electrical equipment is of the same standard as that which was approved and is still approved.

8. No person shall dispose of, attempt to dispose of, or use any electrical equipment other than that which is either approved or accepted.

9. No person shall dispose of or attempt to dispose of any electrical equipment of such a character as experience has shown to be liable or which in the opinion of the Commission is liable to be used in any location or on any electrical circuit or in any manner likely to create conditions hazardous to life or property without affixing to such electrical equipment a plainly printed notice in a form satisfactory to the Commission indicating the correct conditions and manner of use.

10. No person shall dispose of or attempt to dispose of any electrical equipment in any manner which in the opinion of the Commission might lead to or encourage its use in any location or on any electrical circuit or in any manner likely to create conditions hazardous to life or property after having been notified by the Commission not to do so.

11. Each specification, each new edition of a specification, and each addition to or amendment of one shall be in force on the date of issue or adoption by the Commission for use in Ontario, but the Commission at its discretion may in the case of individual specifications grant such period of grace in the application thereof as it deems to be reasonable, in order to prevent hardship.

12. No electrical equipment will be approved by the Commission unless and until,—

- (i) an application for inspection and test of such equipment has been made to the Commission or, when agreeable to the Commission, to the Canadian Engineering Standards Association;

- (ii) the fees prescribed for inspection and test have been paid;
- (iii) such equipment complies with the specifications and other requirements of the Commission therefor;
- (iv) a report evidencing such compliance has been made by an inspector of the Commission, or has been issued by the Canadian Engineering Standards Association in pursuance of inspection and test made by it, and such report has been adopted by the Commission; and
- (v) the manufacturer of such equipment or his agent has entered into and executed the service agreement required by the Commission in connection therewith.

13. No electrical equipment shall be deemed to be approved or accepted unless and until a certificate or other writing to that effect has been signed and issued by an inspector of the Commission duly authorized in that behalf, provided that when the Commission is agreeable to any approved electrical equipment being listed as such in the records or publications for that purpose kept or issued by the Canadian Engineering Standards Association, such listing shall have the same force and effect as the said certificate or writing.

14. If in the opinion of the Commission the standard of design, construction and materials for any approved or accepted electrical equipment is not being maintained in accordance with the specifications and other requirements of the Commission concerning it, or if such equipment is shown by field experience to be unduly hazardous, or if any person refuses or neglects to observe or perform the provisions of any service agreement relating to such equipment, or any of these Rules and Regulations pertaining to such equipment, then the Commission in its absolute discretion may cancel or withdraw the authority to use or dispose of such electrical equipment in Ontario, and thereupon the said equipment shall be deemed to be not approved or not accepted, as the case may be.

ELECTRICAL INSTALLATIONS

15. No person shall perform any electrical work or carry out any installation within the scope of these Rules and Regulations except in the manner prescribed thereby.

16. No electrical equipment shall be installed or used in connection with any electrical work or installation within the scope of these Rules and Regulations unless such electrical equipment has first been either approved or accepted.

17. Where any electrical work or installation within the scope of these Rules and Regulations has been done or carried out in or upon any building, structure or premises, and neglect or default has occurred either,—

- (i) to obtain a permit from the Commission before commencement of the work; or
- (ii) to perform the work in the manner prescribed by these Rules and Regulations; or
- (iii) to remedy defects in materials or workmanship after having been notified by the Commission so to do;

then the Commission in any of the said cases may cut off the supply of electrical power or energy from such building, structure or premises, or any part thereof, or may order the Supply Authority to do so, and the Commission may prohibit the reconnection of such supply for whatever period it may deem necessary for the safety of life or the protection of property.

18. The Commission may refuse to issue a permit or permits to any person who either,—

- (i) has failed to pay any fees due and owing to the Commission for a period of more than thirty (30) days; or
- (ii) has failed to remedy defects in any electrical work or installation after having been notified by the Commission that such defects exists.

19. Notwithstanding anything contained in Rule 507 of these Rules and Regulations, the Commission hereby declares that armoured cable may within the scope of the said Rule be used without special permission.

20. The Commission, in pursuance of Rule 404(h) of these Rules and Regulations, hereby orders and directs that in the Province of Ontario every service box shall be sealed or locked by the Supply Authority, and that no person other than an inspector or any authorized agent of the Supply Authority shall break any such seal or open any such box.

21. The Commission, in pursuance of Rule 208(b) of these Rules and Regulations, hereby directs that written application for inspection of any electrical work or installation shall be filed with the Commission at least twenty-four (24) hours before inspection is desired.

22. The Commission, in pursuance of Rule 208(a) of these Rules and Regulations, hereby prescribes as the schedule therein referred to, the "Schedules of Inspection and other Fees" which are hereinafter published and which list the fees payable to the Commission for permits and inspections.

SCHEDULES OF INSPECTION
AND OTHER FEES

(For List of Schedules, see page H-iii)

Approved by the Hydro-Electric Power Commission of Ontario—
November 30, 1939

Notes:

Payment of an inspection fee entitles a **contractor** or other **person** to one inspection only.

Words, other than titles and sub-titles, appearing in bold-face type in these Schedules and not heretofore defined, shall have the meanings assigned to them in the Definitions contained in that part of these Rules and Regulations known as the Canadian Electrical Code, Part I.

GROUP A

Fees for Permits and for the Inspection of Plans and Specifications, and of Installations of Electrical Equipment and Wiring.

1. BILLBOARDS AND SIMILAR INSTALLATIONS

The regular fees specified for “**Outlets**” shall apply plus the charge for inspection of the service, if any.

Where billboards and similar installations are supplied with energy on a flat-rate basis no charge will be made under “**Services**”.

2. CARNIVALS

An inspection fee of \$7.50 will be charged for each “stand”. The charge for a Temporary **Current Permit** is included in this fee. The permit is good for six (6) days only but may be renewed at the discretion of the **Commission**. A charge of \$5.00 will be made for each re-inspection of equipment and extension of the Temporary **Current Permit** for each successive six (6) days.

3. FIXTURES—I

Basic Schedule

Including Permit Fee of 10 cents

No. of Fixtures	
1 to 3.....	\$0.35
4.....	.60
5.....	.60

For more than 5 fixtures each additional fixture will be charged for at half the rates for additional **outlets** as shown in the schedule of fees under “**Outlets**.”

Note: See also Fixtures—II, Schedule 4—“*Progressive Detailed Schedule*”.

4.

FIXTURES—II

Progressive Detailed Schedule

For inspection of Fixtures, including, in each case, 10 cents for a Permit Fee.

1....\$.35	51....\$ 3.40	101....\$ 5.89	151....\$ 7.64
2.... .35	52.... 3.45	102.... 5.92	152.... 7.67
3.... .35	53.... 3.50	103.... 5.96	153.... 7.71
4.... .60	54.... 3.55	104.... 5.99	154.... 7.74
5.... .60	55.... 3.60	105.... 6.03	155.... 7.78
6.... .68	56.... 3.65	106.... 6.06	156.... 7.81
7.... .75	57.... 3.70	107.... 6.10	157.... 7.85
8.... .83	58.... 3.75	108.... 6.13	158.... 7.88
9.... .90	59.... 3.80	109.... 6.17	159.... 7.92
10.... .98	60.... 3.85	110.... 6.20	160.... 7.95
11.... 1.05	61.... 3.90	111.... 6.24	161.... 7.99
12.... 1.13	62.... 3.95	112.... 6.27	162.... 8.02
13.... 1.20	63.... 4.00	113.... 6.31	163.... 8.06
14.... 1.28	64.... 4.05	114.... 6.34	164.... 8.09
15.... 1.35	65.... 4.10	115.... 6.38	165.... 8.13
16.... 1.43	66.... 4.15	116.... 6.41	166.... 8.16
17.... 1.50	67.... 4.20	117.... 6.45	167.... 8.20
18.... 1.58	68.... 4.25	118.... 6.48	168.... 8.23
19.... 1.65	69.... 4.30	119.... 6.52	169.... 8.27
20.... 1.73	70.... 4.35	120.... 6.55	170.... 8.30
21.... 1.80	71.... 4.40	121.... 6.59	171.... 8.34
22.... 1.88	72.... 4.45	122.... 6.62	172.... 8.37
23.... 1.95	73.... 4.50	123.... 6.66	173.... 8.41
24.... 2.03	74.... 4.55	124.... 6.69	174.... 8.44
25.... 2.10	75.... 4.60	125.... 6.73	175.... 8.48
26.... 2.15	76.... 4.65	126.... 6.76	176.... 8.51
27.... 2.20	77.... 4.70	127.... 6.80	177.... 8.55
28.... 2.25	78.... 4.75	128.... 6.83	178.... 8.58
29.... 2.30	79.... 4.80	129.... 6.87	179.... 8.62
30.... 2.35	80.... 4.85	130.... 6.90	180.... 8.65
31.... 2.40	81.... 4.90	131.... 6.94	181.... 8.69
32.... 2.45	82.... 4.95	132.... 6.97	182.... 8.72
33.... 2.50	83.... 5.00	133.... 7.01	183.... 8.76
34.... 2.55	84.... 5.05	134.... 7.04	184.... 8.79
35.... 2.60	85.... 5.10	135.... 7.08	185.... 8.83
36.... 2.65	86.... 5.15	136.... 7.11	186.... 8.86
37.... 2.70	87.... 5.20	137.... 7.15	187.... 8.90
38.... 2.75	88.... 5.25	138.... 7.18	188.... 8.93
39.... 2.80	89.... 5.30	139.... 7.22	189.... 8.97
40.... 2.85	90.... 5.35	140.... 7.25	190.... 9.00
41.... 2.90	91.... 5.40	141.... 7.29	191.... 9.04
42.... 2.95	92.... 5.45	142.... 7.32	192.... 9.07
43.... 3.00	93.... 5.50	143.... 7.36	193.... 9.11
44.... 3.05	94.... 5.55	144.... 7.39	194.... 9.14
45.... 3.10	95.... 5.60	145.... 7.43	195.... 9.18
46.... 3.15	96.... 5.65	146.... 7.46	196.... 9.21
47.... 3.20	97.... 5.70	147.... 7.50	197.... 9.25
48.... 3.25	98.... 5.75	148.... 7.53	198.... 9.28
49.... 3.30	99.... 5.80	149.... 7.57	199.... 9.32
50.... 3.35	100.... 5.85	150.... 7.60	200.... 9.35

Over two hundred fixtures, $2\frac{1}{2}\text{¢}$ per each additional fixture.

Note: See also Fixtures—I, Schedule 3—Basic Schedule.

5. **FLOOD LIGHTING**

Each **outlet** of 500 watts or over..... \$0.50

Outlets of less than 500 watts capacity will be charged for under Schedule 15.

6. **GAS BURNER AUTOMATIC CONTROL EQUIPMENT**
(Domestic)

Each installation..... \$0.60

The above amount includes a **Permit Fee** of 10 cents.

7. **GASOLINE DISPENSING DEVICES**
Motorless Type

Separate installation of an individual pump..... \$1.00

Each additional pump installed on the same premises by the same **contractor**, if it can be inspected at the same time..... .50

If installed along with other wiring, on the same premises and by the same **contractor**, if the whole installation can be inspected at one time, each pump..... .50

Self-Contained Motor-driven Type

Wiring and connections of the following:—

One double-unit pump..... \$2.00

Each additional double-unit pump on the same premises if installed by the same **contractor** and if inspected at the same time as the first one..... 1.50

One single-unit pump..... 1.50

Each additional single-unit pump on the same premises if installed by the same **contractor** and if inspected at the same time as the first one..... 1.00

One double-unit pump if inspected along with other wiring installed by the same **contractor** on the same premises..... 1.50

One single-unit pump if inspected along with other wiring installed by the same **contractor** on the same premises..... 1.00

Connections only, of the following:—

One double-unit pump.....	\$1.50
Each additional double-unit pump on the same premises if installed by the same contractor and if inspected at the same time as the first one.....	1.00
One single-unit pump.....	1.00
Each additional single-unit pump on the same premises if installed by the same contractor and if inspected at the same time as the first one.....	0.75

8. GENERATORS

The fee for an electric generator shall be the same as for a motor of like capacity.

No charge will be made for an exciter that forms part of an alternator or of a d.c. generator.

9. HEATING APPARATUS (Industrial)

(Electric Furnaces, Enamelling Ovens, Commercial Cooking Ovens, Electric Steam Generators, etc.)

Up to 10	K.W.	Each complete heating unit	\$1.00
11 to 20	"	"	1.50
21 to 40	"	"	2.00
41 to 100	"	"	3.00
101 to 200	"	"	5.00
201 to 500	"	"	7.00
501 to 1000	"	"	10.00
Over 1000	"	"	15.00

10. HEATING AND COOKING APPARATUS. DOMESTIC
(Non-portable Ranges, Heaters, etc.)

(Including Wiring therefor)

One range, or heater.....	\$1.00
---------------------------	--------

If more than one range or heater be installed by the same **contractor** on the same premises and all can be inspected at one time, the fee for each additional range or heater shall be..... .50

If a range or heater, and the wiring thereto, can be inspected at the same time along with any other electrical work done by the same **contractor** on the same premises, the fee for each range or heater shall be50

Connecting a range or heater to an existing range or heater circuit:
Each such connection50

11. ISOLATED POWER PLANTS
(For Farm Lighting, etc.)

Such of the fees herein as are applicable, plus travelling expenses, will be charged.

12. MISCELLANEOUS INSPECTIONS

Inspections of installations which are not covered by any of the Schedules herein or where these Schedules cannot be consistently applied, will be charged for under this heading, at the rate of \$2.00 per hour, or fraction thereof, plus any necessary travelling expenses.

Minimum fee \$2.00

13. MOTORS
(Up to 750 Volts)
Each Motor

Horsepower	
¼ to 5	\$1.00
Over 5 to 7½	1.20
Over 7½ to 10	1.50
Over 10	2.00

Inspection of motors of 1/4 horsepower or less exceeding 10 in number, if grouped together (as in cotton mills) will be charged for at the rates for **outlets**, provided that they have been installed by the same **contractor** and are ready for inspection at one time.

(Over 750 Volts)
Each Motor

Horsepower	
Up to and including 50	\$10.00
51 to 100	12.00
Over 100	15.00

If the wiring for a motor be installed by one **contractor** and the motor itself by another, each **contractor** shall pay one-half of the regular fee.

Minimum charge to each **contractor**..... \$1.00

14. **OIL BURNERS, MECHANICAL-DRAUGHT COAL
 BURNERS, ETC.
 (Domestic)**

Each ordinary installation..... \$1.00

Combination burner and air-conditioning units, each
installation..... 1.25

15. **OUTLETS—I
 Basic Schedule
 (Wiring Only)**

Including Permit Fee of 10 cents

Number of Outlets

1 to 5.....	\$1.10	} Each additional outlet
6 to 25.....	.15	
26 to 100.....	.10	
101 to 200.....	.07	
Over 200.....	.05	

Where only from 1 to 3 **outlets** are installed and where immediate inspection is not necessary, the following charge, including the **Permit** Fee of 10 cents, shall replace the minimum fee shown above.

1 outlet.....	\$0.35
2 outlets.....	0.60
3 outlets.....	0.85

Note: See also Outlets—II, Schedule 16 "Progressive Detailed Schedule"

16.

OUTLETS—II
Progressive Detailed Schedule
(Wiring Only)

For inspection of wiring (only), including, in each case, 10 cents for a **Permit Fee**.

*1....\$ 1.10	51....\$ 6.70	101....\$11.67	151....\$15.17
*2.... 1.10	52.... 6.80	102.... 11.74	152.... 15.24
*3.... 1.10	53.... 6.90	103.... 11.81	153.... 15.31
4.... 1.10	54.... 7.00	104.... 11.88	154.... 15.38
5.... 1.10	55.... 7.10	105.... 11.95	155.... 15.45
6.... 1.25	56.... 7.20	106.... 12.02	156.... 15.52
7.... 1.40	57.... 7.30	107.... 12.09	157.... 15.59
8.... 1.55	58.... 7.40	108.... 12.16	158.... 15.66
9.... 1.70	59.... 7.50	109.... 12.23	159.... 15.73
10.... 1.85	60.... 7.60	110.... 12.30	160.... 15.80
11.... 2.00	61.... 7.70	111.... 12.37	161.... 15.87
12.... 2.15	62.... 7.80	112.... 12.44	162.... 15.94
13.... 2.30	63.... 7.90	113.... 12.51	163.... 16.01
14.... 2.45	64.... 8.00	114.... 12.58	164.... 16.08
15.... 2.60	65.... 8.10	115.... 12.65	165.... 16.15
16.... 2.75	66.... 8.20	116.... 12.72	166.... 16.22
17.... 2.90	67.... 8.30	117.... 12.79	167.... 16.29
18.... 3.05	68.... 8.40	118.... 12.86	168.... 16.36
19.... 3.20	69.... 8.50	119.... 12.93	169.... 16.43
20.... 3.35	70.... 8.60	120.... 13.00	170.... 16.50
21.... 3.50	71.... 8.70	121.... 13.07	171.... 16.57
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40.... 5.60	90.... 10.60	140.... 14.40	190.... 17.90
41.... 5.70	91.... 10.70	141.... 14.47	191.... 17.97
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44.... 6.00	94.... 11.00	144.... 14.68	194.... 18.18
45.... 6.10	95.... 11.10	145.... 14.75	195.... 18.25
46.... 6.20	96.... 11.20	146.... 14.82	196.... 18.32
47.... 6.30	97.... 11.30	147.... 14.89	197.... 18.39
48.... 6.40	98.... 11.40	148.... 14.96	198.... 18.46
49.... 6.50	99.... 11.50	149.... 15.03	199.... 18.53
50.... 6.60	100.... 11.60	150.... 15.10	200.... 18.60

Over two hundred outlets, five cents per each additional outlet.

**See also Outlets—I, Schedule 15, "Basic Schedule".*

17. OUTLINE LIGHTING

The charge will be one-half ($\frac{1}{2}$) of the regular fee specified for **outlets**. This applies to **outlets** spaced at not more than (about) 24 inch centres.

18. PANELBOARDS AND DISTRIBUTION PANELS

Number of Circuits

5 to 8.....	\$1.00
9 to 16.....	1.50
17 to 24.....	2.00
25 to 32.....	2.50
Over 32, each additional circuit.....	.10

No charge will be made for inspecting **panelboards** and **over-current device cabinets** installed in residences and in the individual suites of apartment houses.

19. PERMITS
(Annual Permits)

No. of Employes	Annual Fee
100 or less.....	\$ 15.00
101 to 250.....	25.00
251 to 500.....	50.00
501 to 1,000.....	100.00
Each additional 500.....	100.00

In all manufacturing, mercantile or other **buildings** where the occupants employ their own electricians and where the nature of their business necessitates the making of sundry changes, additions and repairs, to the plant at short notice—e.g., moving lights, motors or other **electrical equipment**—such changes, etc., may be made by the occupant's own electricians, from time to time, without the formality of taking out a **permit** for each such change, etc. (as is required by Clause (a) of Rule 208 herein), provided that the occupant has obtained an Annual **Permit** from the **Commission**, in the Inspection District in which the premises in question are situated.

An Annual **Permit** may be granted, at the discretion of the **Commission**, upon payment of a fee in accordance with the foregoing Schedule—this will permit the occupant's own electricians to proceed with such emergency changes, etc., as the nature of the business demands.

Following the issue of a new Annual **Permit** (not the renewal of an existing one) the **Commission** shall make a general inspection of the occupant's premises, specifically designated in

the said Annual **Permit**, and shall deliver to the occupant, within a period of thirty days, a report concerning the electrical installation in the occupant's said premises.

The **Commission** shall deliver to the occupant, a form upon which the occupant shall record or cause to be recorded, all changes and additions made to the electrical installation by the occupant's own electricians. This record shall commence on the day upon which the Annual **Permit** is issued.

The occupant shall be entitled to an inspection at any time upon making a written request to the **Commission**.

20. **PERMITS**
(Installation Permits)

Each Permit..... \$0.10

This amount is included in each of the "Progressive Detailed Schedules" for "Fixtures" and for "Outlets,"—Schedules Nos. 4 and 16, respectively—and shall be paid, together with the inspection fees, in full.

21. **PERMITS**
(Temporary Permits)
(Valid for 30 days only)
(See also "Carnivals", Schedule No. 2)

Residences and duplex houses, and apartment houses containing not more than two apartments.

Each permit..... \$0.60

Apartment or duplex houses containing more than two apartments, office buildings, factories, etc.

For lighting only..... \$1.00

For power only..... \$1.00

For light and power under one permit..... \$1.50

In addition to the above fees the regular charges for inspection shall be paid at the time when application is made for a Temporary **Permit**.

Temporary **Current-permits** will be issued at the discretion of the **Commission** to enable **Supply Authorities** to connect their lines to temporary work or to unfinished permanent work, and may be renewed at the discretion of the **Commission**, on payment of a fee of the same amount. In the event of a Temporary **Current-permit** not being renewed, the **Supply Authority** will be obliged to discontinue the supply of current to the premises in question, without notice, upon expiration of such permit.

The issuing of a Temporary **Permit** by the **Commission** in no way obliges it to issue to the **Supply Authority** a **Current-permit** authorizing the supply of current to the premises if, after an inspection has been made, the supplying of current would, in the opinion of the **Commission**, be hazardous to life and/or property, or if all **Permits** required for the complete installation have not been obtained.

22. PLANS AND SPECIFICATIONS FOR ELECTRICAL INSTALLATIONS

(Examination and Approval of)

Low-potential Installations (0-750 Volts)

Apartment Houses—

Up to 4 apartments.....	\$1.00
Every additional apartment up to and including 10 ....	.25
Every additional apartment over 10.....	.15

Note: Any store built into an apartment building will be classed as an apartment.

Churches and Charitable Institutions..... \$1.00

Factories, General—

Up to 5,000 sq. ft. floor area.....	\$2.00
Every additional 5,000 sq. ft. floor area or fraction thereof	1.00

Factories used for Light Manufacturing Purposes—

Up to 10,000 sq. ft. floor area.....	\$3.00
Every additional 10,000 sq. ft. floor area or fraction thereof.....	1.00

Garages—

Up to 5,000 sq. ft. floor area.....	\$2.00
Every additional 10,000 sq. ft. or fraction thereof.....	1.00

Office Buildings, Hotels and Departmental Stores—

Ground floor and basement.....	\$10.00
Every additional 10,000 sq. ft. floor area or fraction thereof.....	1.00

Residences—

Up to 8 rooms.....	\$0.50
9 to 15 rooms.....	.75
Over 15 rooms.....	1.00

Schools—	
Ordinary.....	\$ 2.00
Technical.....	10.00
Stores, other than Departmental.....	
Theatres—	
Up to 500 seats capacity.....	\$5.00
Every additional 500 seats capacity or fraction thereof..	5.00
Warehouses—	
Ground floor and basement.....	\$2.00
Every additional floor.....	1.00
Cold Storage Warehouses—above fees plus.....	10.00

High-potential Installations (over 750 Volts)

The fees charged for examination and approval of plans and specifications covering high-potential installations will be at the rate of \$3.25 per hour, or fraction thereof.

Where plans and specifications include both **Low-potential** and **High-potential** systems, the fees charged will be based on the **Low-potential** section of this Schedule, plus a charge of \$3.25 per hour, or fraction thereof, covering time required in connection with the examination and approval of the **High-potential** layout.

23. **REFUNDS**

If more than one application be filed, in error, for the same installation, or if for any reason inspection fees have been over-paid, the amount in excess will be refunded. When a refund is asked for, the receipt shall be presented at the District office.

24. **SERVICES**
(Up to 750 Volts)

Amperes	
30 and 60.....	\$1.00
100.....	1.50
200.....	2.00
400.....	2.50
600.....	4.50
1,200.....	6.50
2,400.....	8.50
Each additional sub-service switch if installed at the same time as the main service equipment and by the same contractor.	
\$0.10	

If a **service** enters a building in which two or more **service-entrance switches** are used in parallel to disconnect the installation from the source of supply, each such **switch** shall under this schedule be classed as a separate **service switch**.

In duplex houses and on similar installations, where from two to four meters are required and where no master **switch** is installed, the charge for **service** inspection shall be figured as for one **service** of the combined capacity of the individual **service switches**, plus 10 cents for each **service switch**.

Over 750 Volts

Each. \$5.00

*Note: This fee covers the inspection of the **service-entrance**, the **isolating switches**, and oil (or other) **circuit-breaker**, but will not be charged where the **service** equipment is mounted on a **switchboard**.*

25. SIGNS AND MARQUEE LIGHTING

Wiring for and connection of one ordinary sign or marquee \$1.00

Wiring for and connection of one motor-operated sign or motor-operated marquee. \$3.00

If more than one sign or marquee be installed on the same premises by the same **contractor** and if all can be inspected at one time the fee for each additional sign or marquee will be:

Wiring for and connection of each additional sign or marquee. \$0.50

Wiring for and connection of each additional motor-operated sign or marquee. \$1.50

Where the wiring for a sign or marquee is installed by one **contractor** and the sign or marquee is connected by another **contractor** the fee will be:

Wiring only, for each ordinary sign or marquee. \$0.50

Wiring only, for each motor-operated sign or motor-operated marquee. \$1.50

Connection only, each ordinary sign or marquee. \$0.50

Connection only, each motor-operated sign or motor-operated marquee. \$1.50

Contractors and others making application for inspection of sign or marquee wiring shall specify, on the application form, whether the equipment is of the motor-operated flasher, or continuous, type. Signs or marquees of the intermittent type controlled by thermal devices shall be classed as ordinary signs.

The above schedule applies only to inspection of electric signs bearing an **approval label**—this means inspection of the **service**, of the **feeders** to the sign and the connection of the sign. The schedule does not apply to outline-lighting, billboards, or to any device which might be considered to be a sign, but which does not bear an **approval label**.

Note: See "Billboards and Similar Installations," Schedule 1.

26.

SWITCHBOARDS

(Complete Board)

Each switchboard , voltages up to 750.....	\$5.00
Each additional switchboard , voltages up to 750, installed by the same contractor on the same premises and if all can be inspected at one time.....	\$2.50
Each switchboard , voltages over 750.....	\$10.00
Each additional switchboard , voltages over 750, installed by the same contractor on the same premises and if all can be inspected at one time.....	\$5.00

27.

THEATRES(Inspection of equipment used by travelling shows
and stock companies).

Inspection of **electrical equipment** to be used on the stages of theatres will be made by the **Commission** before the performance of each "stand". Use of such equipment prior to inspection is not permitted.

Fee (inclusive of 10 cents, **Permit Fee**)..... \$1.10

For stock companies, inspection of **electrical equipment** to be used on the stages of theatres will be made each week prior to the opening of the show.

Fee for each weekly inspection..... \$0.60

28.

TRANSFORMERS

(Air or oil-cooled)

Up to 750 Primary Voltage

Kilowatts

1 to 5.....	each transformer	\$ 1.00
6 to 10.....	" "	1.50
11 to 20.....	" "	2.00
21 to 30.....	" "	2.50
Over 30.....	" "	4.00

Over 750 Primary Voltage

1 to 10.....	each transformer	\$2.00
11 to 20.....	" "	3.50
21 to 30.....	" "	5.00
31 to 50.....	" "	6.00
51 to 100.....	" "	7.00
101 to 200.....	" "	8.00
Over 200.....	" "	10.00

29. UNIT HEATERS

(Combination radiator and blower heaters)

Each unit, up to four (4) in number.....	\$0.50
Each additional unit installed by the same contractor on the same premises, if all can be inspected at one time....	.25

30. WINDOW STRIP-LIGHTING, COVE LIGHTING, ETC.

The charge will be one-half ($\frac{1}{2}$) of the regular fee specified for "Wiring (only)."

Minimum fee.....	\$1.00
------------------	--------

31. X-RAY EQUIPMENT, HIGH FREQUENCY APPARATUS ETC.

Wiring for low-voltage or primary circuit.....	\$2.00
Wiring for high-voltage or secondary circuit.....	\$5.00

GROUP B

Fees for inspection and acceptance by the Inspection Department of electrical equipment which has not been otherwise approved.

32. SPECIAL INSPECTIONS

The fee for this service shall be based upon the time spent by the inspectors of the Commission in making the necessary investigation, at the rate of \$3.00 per hour, or fraction thereof, plus any necessary travelling expenses.

Minimum Fee.....	\$5.00
------------------	--------

C22.1—1939

**CANADIAN ENGINEERING STANDARDS
ASSOCIATION**

INCORPORATED 1919

◆
CANADIAN ELECTRICAL CODE

PART I

(Fourth Edition)

**Essential Requirements and Minimum Standards
Governing Electrical Installations
for
Buildings, Structures and Premises
— *All Potentials* —**

•
C.E.S.A. STANDARD

1939



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ASSOCIATION**

OTTAWA, AUGUST, 1939

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PREFACE TO FOURTH EDITION

SINCE the appearance of the third edition of the Canadian Electrical Code in the year 1935, the Code Committee and its Procedure have been completely reorganized. As a result of the general feeling that the existing method of carrying on the revision work was cumbersome and slow, and resulted in considerable inconvenience to the industry as a whole, the Executive Committee requested the Chairman of the Code Committee to bring in a report suggesting a suitable revised organization and procedure. A conference was held in Toronto in June, 1938, which was attended by Provincial Electrical Inspectors from practically all Provinces. The various committees were reorganized and a procedure for their guidance set up. In Appendices B and C will be found the procedure for the Committees on Part I and Part II respectively. It will be noted that inspection and Underwriters' interests form the majority of the Part I Committee, and that manufacturers' representatives form fifty per cent of the membership of Part II Committee. Part I Committee will review and pass upon the work of Part II Committee and itself reports direct to the C.E.S.A. Main Committee. Special attention is called to the *Central Committee* which is given considerable responsibility in all stages of the work.

It is hoped that the new organization and procedure will greatly expedite the Code work.

The first meeting of the Committee under the new procedure was held in Winnipeg on May 1, 2 and 3, 1939, and the present revision is the result of this meeting.

Among the features of this edition to which special attention may be called are the following:—

1. *Definition of "Approved."* The Toronto Conference mentioned above, recommended to the Executive Committee that steps be taken whereby all approvals in Canada would be issued in the name of the Canadian Engineering Standards Association and this is now being worked out by a sub-committee of the Executive, and it is expected that arrangements will be completed between the Canadian Engineering Standards Association, the National Research Council and The Hydro-Electric Power Commission of Ontario before the end of the year. Under the new arrangement, the C.E.S.A. will not set up laboratories, but those laboratories now carrying on approvals work will continue as agents of the Canadian Engineering Standards Association.
2. The recognition of *radio interference* as a Code responsibility and the undertaking of the preparation of special rules forms an important new departure in the activities

of the Code Committee. A new section of the Canadian Electrical Code, to be designated, "Part IV," will include rules governing radio interference and a Special Committee has been organized to prepare them. Practically all the material in Section 37 of Part I has been transferred to Part IV. The Department of Transport has been empowered to prepare and enforce regulations throughout Canada for the control of radio interference, and has requested the Canadian Engineering Standards Association to assist in the preparation of the regulations. This involves methods of measuring radio interference, limits and tolerances governing interference and eventually the extension of the approvals testing to the certification of electrical equipment with respect to its radio interference characteristics.

3. Attention is called also to the raising of the voltage limit to which the Code is applicable. This was formerly 5000 and is now extended, *without limit*.
4. Changes in arrangement have been made in several sections and new sections have been added. Thus, a portion of former Section 8, dealing with "*Control Equipment*," becomes a new "Section 7", and Section 8 now deals with "*Protection*."

In Section 9 important changes have been made resulting from representations of power companies. Ohmic values of the various types of grounds recognized now appear in the rules of this section, whereas they were formerly in the "Definitions" section.

Section 32 has been amplified in detail but restricted in its application to locations where explosive hazards may exist.

A new "Section 33" deals with locations such as garages and service or filling stations, and Section 34, with locations where excessive moisture or corrosive agents are present.

Numerous changes have been made in Sections 20 and 50; the latter includes all the rules for high-potential installations.

Acknowledgment is made for the use of material contained in the National Electrical Code, and the National Electrical Safety Code. The Rules of the Institution of Electrical Engineers and of the Standards Association of Australia have also been of assistance.

Special acknowledgment is made of the services rendered by Mr. A. S. L. Barnes during the preparation of the fourth edition, including the compiling of the detailed index, suggestions for clarification of text and the checking of proofs in the various stages of printing.

CANADIAN ELECTRICAL CODE, PART I

4th Edition

Procedure for

General Revision, Interim Revision, Interpretation, etc.

Attention is directed to Appendix B (page 196) which gives a general outline of the organization of the various committees responsible for the preparation of new editions of the Canadian Electrical Code, Part I.

Also, is included, the Procedure for general revision of the Code, as well as for disposal of requests for interim revision of rules in the current edition of the Code when such interim revision is considered by the applicant to be of such importance as to require action prior to the next subsequent general revision.

Likewise, the Procedure for making requests for interpretations of existing rules is concisely stated.

CANADIAN ELECTRICAL CODE, PART II

(Approvals Specifications)

Procedure in Preparation of Specifications

Appendix C (page 203) concerns the organization of the Committee on Canadian Electrical Code, Part II, which is responsible for preparation of specifications upon which the approval of electrical equipment and appliances in Canada is based. The Procedure to be followed in the preparation of such specifications is included in this Appendix.

The list of C.E.S.A. Approvals Specifications comprises to date some 60 separate standards and is available on request.

CANADIAN ELECTRICAL CODE, PART I

FOURTH EDITION

OBJECT OF THE CODE

This Code is intended to establish essential requirements and *minimum* standards for the installation and maintenance of **electrical equipment** for adoption and enforcement by **Electrical Inspection Departments** throughout the Dominion of Canada.

In its preparation consideration has been given, not only to prevention of fire hazard and injury to persons and property, but also to proper maintenance and operation.

This Code has been prepared with due regard to recognized electrical codes now in force, particularly the "National Electrical Code," and the "National Electrical Safety Code."

SCOPE AND GENERAL ARRANGEMENT

This Code is designated "The Canadian Electrical Code—Part I." It governs all electrical work and **electrical equipment** operating or intended to operate at all potentials in electrical installations for **buildings**, structures and premises with the following exceptions:

1. Installations for equipment employed by an electric or communication utility in the exercise of its function as a utility, and located outdoors or in **buildings** used exclusively for that purpose except as covered by Rule 902.
2. Car wiring, car houses, passenger and freight stations used in the operation of electric railways and supplied with the electric current from the railway power circuit.
3. Mines.
4. Aircraft and marine work.

The Code is divided into numbered Sections, each one covering some main division of the work. The Sections are divided into numbered Rules, and each Rule is further divided into Clauses covering the individual features relating to the Rule and designated, for easy reference, by letters of the alphabet.

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SECTION I—DEFINITIONS OF SPECIAL TERMS

The following definitions give the meanings of the principal special terms used in this Code. Derivatives of defined words shall be interpreted in accordance with the corresponding definitions.

Note: All terms intended to convey the meanings given below are printed in bold-faced type throughout the text. Terms which are defined, if not printed in bold-faced type, and also words or terms not specifically defined, shall be interpreted as commonly understood.

Absorption-resisting: Incapable of taking up water (or any other liquid deleterious to the material under consideration, to which such material is liable to be exposed) sufficiently to affect electrical or mechanical properties to an appreciable extent under the conditions of use.

Accessible: Not permanently closed in by the structure or finish of the building. (See **Readily Accessible**).

Alive or Live: Electrically connected to a source of potential difference, or electrically charged, so as to have a potential different from that of the earth.

Note: These terms are sometimes used in place of "current-carrying," where the intent is clear, to avoid repetition of the longer term.

Approved: When used with reference to any particular electrical equipment means that such equipment has been submitted for examination and test to the C.E.S.A. and that formal **approval** has been given to the effect that it conforms to the C.E.S.A. Standards as established under the provisions of the Canadian Electrical Code.

*Note: The C.E.S.A. proposes to authorise Laboratories to examine and test electrical equipment, and these Laboratories will issue reports to the C.E.S.A., and **approvals** based thereon will be issued by the C.E.S.A. The C.E.S.A. further proposes to institute a follow-up service (re-examination or label service).*

(For information in detail see the C.E.S.A. Approvals Manual, to be published.)

Approved Fire-door: A (so-called) fire-door of a type **approved** for the class of service to which it is applied, and labelled under the supervision of the Underwriters' Laboratories of Canada or Underwriters' Laboratories Incorporated.

Armoured-cable: A cable provided with a wrapping of metal (usually tapes or wires) forming an integral part of the assembly, primarily for the purpose of mechanical protection.

Note: Lead is not considered to be capable of affording such protection.

Authorized Person: A **qualified person** who by the nature of his duties or occupation is obliged to approach or handle **electrical equipment**; or, a person who, having been warned of the hazards involved, has been instructed or authorized to do so by someone in authority.

Auxiliary Gutter: A sheet-metal enclosure for **conductors**, cables and bus bars at **switchboards**, meter centres, distribution centres and similar points.

B. & S. Gauge: The Brown and Sharpe (or American) Wire Gauge as applied to non-ferrous **conductors** and non-ferrous sheet metal.

*Note: The Gauge No. of a stranded **conductor** will be interpreted to mean that the sum of the cross-sectional areas of the component strands, measured at right angles to their axes, is equal to that of a solid **conductor** of the same Gauge No.*

Branch-circuit: That portion of a circuit extending beyond the final **over-current devices** on the circuit.

Note: The term includes circuits for both lighting and power.

Building: A structure which stands alone or which is cut off from adjoining structures by unpierced fire-walls, or by openings protected by **approved fire-doors**.

Bus: A **conductor** which serves as a common connection for the corresponding **conductors** of 2 or more circuits.

Busway: An **approved**, completely-assembled metal troughing and fittings therefor, containing bare **conductors** intended for use as **feeders**, the **conductors** being suitably supported on **insulators**.

Cabinet: An enclosure of adequate mechanical strength, composed entirely of **fire-** and **absorption-resisting** material, designed either for surface or flush mounting and provided with a frame, matt, or trim, in which swinging doors are hung.

Circuit-breaker: An electro-mechanical device designed to open, under both overload and short-circuit conditions, a current-carrying circuit, without injury to the device. As used in this Code, this term applies only to the automatic type designed to trip on a pre-determined over-current.

Communication System: See **System**.

Concealed: Rendered permanently **inaccessible** by the structure or finish of the **building**.

Conductor: A wire or cable, or other form of metal, installed for the purpose of conveying electric current from one piece of **electrical equipment** to another.

Conduit: See "**Flexible**" and "**Rigid**" **Conduit**.

Contractor: Any firm, corporation, company, organization, or other persons or person undertaking to perform any work within the scope of this Code.

Current-permit: Written permission from the **Inspection Department** to a **Supply Authority** to the effect that electric energy may be supplied to a particular installation.

Cut-out Box: An enclosure of adequate mechanical strength, composed entirely of **fire-** and **absorption-resisting** material, designed for surface mounting and having swinging doors or covers secured directly to, and telescoping with, the walls of the box proper.

Damp Place: Any place in which moisture is present, either permanently or intermittently, to such an extent that it would be likely to impair the effectiveness of an installation conforming to the minimum requirements for **ordinary conditions**.

Dead: Free from any electrical connection to a source of potential difference and from electrical charge; not having a potential different from that of the earth.

*Note: The term "dead" is used only with reference to current-carrying parts when these parts are not **alive**.*

Dead-front: So constructed that all **live** parts are enclosed in such a manner as to be **inaccessible** to **unauthorized** persons.

*Note: **Panelboards** and enclosed **branch-circuit cutouts** in which all **live** parts except the wells for plug fuses are enclosed, are considered to be of the **dead-front** type.*

Different Systems: Those which derive their energy from different transformers or from different banks of transformers, or from different generators or other sources.

Disconnecting Switch: See **Isolating Switch**.

Dumbwaiter: A hoisting and lowering mechanism equipped with a car, which moves in guides in a substantially vertical direction, the floor area of which does not exceed 9 sq. ft., whose compartment height does not exceed 3 ft. 6 in., the capacity of which does not exceed 500 lbs., and which is used exclusively for carrying freight.

Dust-tight: So constructed that dust cannot enter the enclosing case.

Electrical Equipment: Any equipment, machinery, apparatus, appliances, instruments, devices, fittings, or materials designed for, used in, or intended to be used in, the generation, transformation, transmission, distribution, supply or utilization of electric energy.

Electric Elevator: One in which the motion of the car is obtained through an electric motor directly applied to the **elevator machinery**.

Elevator: A hoisting and lowering mechanism equipped with a car or platform which moves in guides in a substantially vertical direction.

Note: Dumbwaiters, endless belts, conveyors, chains, buckets, etc., used for the purpose of elevating materials, and tiering or piling machines operating within one storey, are not included in the term "Elevator".

Elevator Machine: The machinery and its equipment used in raising and lowering the **elevator** car or platform.

Emergency Lights: All lights, in a **theatre**, or other **building** used for public assembly, which, for the purpose of facilitating safe exit in case of fire or other emergency, are intended to be kept lighted continuously while the **theatre** or **building** is open to the public.

Enclosed: See **Motor: Enclosed**,

Explosion-proof: Enclosed in a case which is constructed to withstand an explosion of a specified gas or dust which may occur within it and to prevent the ignition of the specified gas or dust surrounding the enclosure by sparks, flashes, or explosions of the specified gas or dust, which may occur within the enclosure.

Exposed: Any current-carrying part of **electrical equipment** which can be inadvertently touched, or approached more closely than is safe, by any person, is considered to be **exposed**. The term is applied to objects not suitably **guarded** or isolated.

Feeder: Those **conductors** of a circuit which run from **service** equipment to the first set of **overcurrent devices**.

Feeder: Sub, Those **conductors** of a circuit, which, being themselves supplied by a **feeder** and having **overcurrent** protection, supply, or are intended to supply, two or more **branch-circuits**.

Fire-door: See **Approved Fire-door**.

Fireproof (or Fire-resisting): As applied to **buildings** or portions thereof, means that they are of approved masonry, reinforced concrete or other equivalent construction.

Note: For detailed information see the Building Code of the National Board of Fire Underwriters.

Flammable: This term is applied to readily combustible materials such as straw, hay, wood shavings, light draperies, celluloid, oils, gasoline, etc.

Flexible Conduit: Flexible metal conduit into which it is intended that **conductors** shall be drawn.

Flexible Tubing: Flexible non-metallic tubing, commonly known as "loom", into which it is intended that a **conductor** shall be drawn.

Fuses: See **Over-current Devices**.

Garage: A **building** or portion of a **building** in which one or more self-propelled vehicles carrying volatile, **flammable** liquid for fuel or power are kept for use, sale, storage, rental, repair, exhibition or demonstration purposes.

Gas-tight: So constructed that gas cannot enter the enclosing case.

General-use Switch: A **switch** intended for use in general distribution and **branch-circuits**. It is rated in amperes and is capable of interrupting its rated current at rated voltage.

Ground: A connection to earth obtained by a **ground electrode**.

Note: For grounds for Class 2 Communication Systems see Section 60.

Ground, Communication Systems: (See Rule 6003).

Grounded: Connected effectually with the general mass of the earth through a **grounding system** having current-carrying capacity sufficient at all times, under the most severe conditions which are liable to arise in practice, to prevent any current in the **grounding conductor** from causing a harmful voltage to exist:

- (1) Between the **grounded conductors** and neighbouring exposed conducting surfaces which are in good contact with the earth, or
- (2) Between the **grounded conductors** and neighbouring surfaces of the earth itself.

Grounding-conductor: A path of suitable metal specially arranged as a means whereby **electrical equipment** is electrically connected to a **ground electrode**. In the case of flexible cords containing a **grounding-conductor** the **grounding-conductor** may be **uninsulated**, or, if **insulated**, green.

Grounding System: All those cables and other **conductors**, clamps, **ground clips** and **ground plates** or pipes by means of which the electrical installation is **grounded** including the **ground electrodes** to which such cable and other **conductors**, clamps and clips are attached.

Ground-electrode: A buried metallic water-piping system, or metal object or device buried in, or driven into, the ground (so as to make intimate contact therewith) to which a **grounding-conductor** is electrically and mechanically connected.

Guarded: Covered, shielded, fenced, enclosed, or otherwise protected by means of suitable covers, or casings, barriers, rails or screens, mats or platforms, to remove the likelihood of dangerous contact or approach by persons or objects.

Hazardous Locations: Premises, locations, rooms or portions thereof:

- (1) Where highly **flammable** gases, **flammable** volatile liquids, mixtures (such as polishing pastes, etc.) or other highly **flammable** substances, are manufactured or used, or are stored in other than original containers; or
- (2) Where combustible dust or flyings are likely to be present in quantities sufficient to produce an explosive or combustible mixture; or where it is impracticable to

prevent such dust or flyings from collecting in or upon motors or other **electrical equipment** in such quantities as to produce overheating through normal radiation being prevented, or from being deposited upon incandescent lamps; or

- (3) Where easily ignitable fibres or materials producing combustible flyings are manufactured, handled or used in a free open state; or
- (4) Where easily ignitable fibres or materials producing combustible flyings are stored in bales or containers but are not manufactured or handled in a free open state.

Hoistway: Any shaftway, hatchway, well hole, or other vertical opening or space in which an **elevator** or **dumb-waiter** is designed to operate.

Identified: Applied to a **conductor** means a white or grey covering or separator, or a tracer in the outer braid, or other approved means of **identification**; applied to other **electrical equipment**, means that some terminal thereon is distinguished by being tinned, nickel-plated or otherwise effectively marked for **identification** in an approved manner. The **identified conductor** must in all cases be the **neutral** or the **grounded conductor**.

Inaccessible: Covered by the structure or finish of the **building**, or sufficiently remote from access, or so placed or **guarded**, that **unauthorized persons** cannot, inadvertently, touch, interfere with or enter the equipment, room or compartment to which the term is applied.

Incombustible: Incapable of sustaining combustion in air, either when ignited or when subjected to, and maintained at, a high temperature.

Indicating Switch: A **switch** of such design, or so marked, that the fact as to whether it is "on" or "off" may be readily determined by inspection.

Industrial Control Board: A panel or assembly of panels or structures on which are mounted any combinations of switching, measuring, control, and protective devices, **buses** and connections, designed with a view to successfully carrying and rupturing the normal starting and overload currents of the **electrical equipment** controlled. (See also **Panelboard**; **Panelboard, Enclosed**; and **Switchboard**.)

Industrial Establishment: A **building** or part of a **building** (other than office or exhibit space) where persons are employed in manufacturing processes or in the handling of material, as distinguished from dwellings, offices and like occupancies.

Inspection Department: An organization legally authorized to enforce this Code and having jurisdiction over specified territory.

Inspector: Any person duly appointed by the **Inspection Department** for the purpose of enforcing this Code.

Insulated: A term applied to conducting surfaces separated from adjacent surfaces either by a non-conducting substance or an air-space offering, permanently, so high a resistance to the passage of current or to disruptive discharges through or over the surface of the substance or space, as to obviate danger of shock and injurious leakage of current. When an object is said to be **insulated**, it is understood to be **insulated** to a degree suitable for the conditions for which it has been **approved**. Otherwise, it is, for the purpose of this Code, considered to be **uninsulated**.

Insulating: A term applied to non-conducting substances capable of bringing about the condition defined as **insulated**.

Isolating Switch: A **switch** intended for isolating either a circuit or some equipment from its source of supply. It is not intended either for establishing or interrupting the flow of current in any circuit.

Knife-switch: A **switch** in which the moving element is in the form of a blade, usually hinged, which enters or embraces contact clips.

Lampholder: A device constructed for the mechanical support of lamps and for connecting them to circuit **conductors**.

Live: See **Alive**.

Low-voltage Protection: The effect of a device operative on the reduction or failure of voltage to cause and maintain the interruption of power to the main circuit.

Low-voltage Release: The effect of a device operative on the reduction or failure of voltage to cause the interruption of power to the main circuit, but not to prevent its re-establishment on the return of voltage to a safe operating value.

Metallic Water-piping System:

- (1) An active, underground, public water-supply system having metallic mains and services; or
- (2) An active, underground, private water-supply system having at least 100 ft. of metal pipe buried in the ground; or
- (3) The metallic casing, not less than 3 in. in diameter, of an artesian well.

Metal Raceway: See **Raceway, Metal.**

Motor, Enclosed: A motor totally enclosed by metal but not necessarily **dust-tight**.

Motor, General-use: A motor constructed for use under **ordinary conditions** only, and of the **open**, the **protected** or the **enclosed** type. (See also **Open**; **Protected**; and **Motor, Enclosed**.)

Motor-circuit Switch: A **switch** rated in horsepower.

Neutral: That **conductor** of a multi-wire **system** which is maintained at an intermediate and approximately uniform potential in respect to the other **conductors**.

Open: A term applied to a motor or other electrical machine or device constructed for use under **ordinary conditions** only, and in which moving parts (if any), and windings or other **live** parts, are **exposed** to accidental contact. (See also **Motor, Enclosed**; **Motor, General-use**; and **Protected**.)

*Note: Equipment of this type may only be used in locations where the entire equipment is **inaccessible** to **unauthorized** persons, or where, after installation of the equipment, the parts referred to are not **exposed** to accidental contact.*

Ordinary Conditions: Such as obtain in ordinary dwellings, offices, factories, etc., in which, normally, **electrical equipment** is not unduly exposed to danger from mechanical injury, excessive moisture, or extreme temperatures and in which it is entirely free from danger from corrosive, **flammable** or explosive atmospheres.

Outlet: Any fixed point on a **branch-circuit** from which it is intended that current shall be taken to supply or control current-consuming equipment.

*Note: The "fixed point" here referred to is to be considered as being on the **conductors** of the circuit; it does not include any current-carrying devices such as **receptacles** or **lamp-holders**.*

- Out-of-Reach:** If the parts considered be more than 5 ft. horizontally, and/or more than 8 ft. vertically, from any floor, platform, etc., from which they would otherwise be accessible, they will be considered as being **out-of-reach**.
- Over-current Device:** Any device capable of automatically opening an electric circuit both under predetermined overload and short-circuit conditions, either by fusing of metal or by electro-mechanical means.
- Overload Device:** A device affording overcurrent, but not necessarily short-circuit, protection, and capable of automatically opening an electric circuit either by the fusing of metal or by electro-mechanical means. (See also **Over-current Devices**.)
- Panelboard:** An assembly of **buses** and connections, **over-current devices** and control apparatus with or without **switches**, or other equipment, constructed for installation as a complete unit in a **cabinet** or **cutout box**. (See also **Panelboard, Enclosed**; **Industrial Control Board**; and **Switchboard**).
- Panelboard, Enclosed:** An assembly of **buses** and connections, **overcurrent devices** and control apparatus with or without **switches**, or other equipment, installed in a **cabinet** or **cut-out box**. (See also **Industrial Control Board**; **Panelboard**; and **Switchboard**.)
- Permit:** Official written permission of the **Inspection Department**, on a form provided for the purpose, authorizing work to be commenced on any electrical installation. (See also **Current-permit**).
- Portable:** A term applied to **electrical equipment** which is not specifically designed to be used in a fixed position and which receives current through the medium of a flexible cord or cable and, usually, a detachable plug.
- Potential, Extra Low:** Any potential up to and including 30 volts.
- Potential, Low:** Any potential from 31 to 750 volts inclusive.
- Potential, High:** Any potential above 750 volts.
- Protected:** A term applied to a motor or other electrical machine or device constructed for use under **ordinary conditions** only, and in which those portions of moving parts (if any), and of windings or other **live** parts, which

are opposite to or in line with openings in the frame or enclosure are protected against accidental contact. (See also **Motor, Enclosed**; **Motor, General-use**; and **Open**.)

Note: The protection afforded shall, except as noted in Item (3) below, prevent the passage, through the openings, of a straight rod of circular cross-section and 1/2 in. in diameter, and may take one or other of the following forms:

(1) *Openings may themselves be of such shape and dimensions as to prevent the passage of the 1/2 in. rod.*

(2) *Openings may be covered with wire screens, expanded metal, or perforated metal, having openings not exceeding 1/2 sq. in. in area and of such shape as to prevent the passage of the 1/2 in. rod.*

(3) *Alternatively to the foregoing, if the distance between the outside surface of the frame or enclosure and those portions of the moving or live parts opposite to an opening be more than 4 in., the limiting diameter of the rod may be 3/4 in.; and the limiting area of opening specified in Item (2) may be 3/4 sq. in.*

Qualified Person: One who, as the result of training and experience, is familiar with **electrical equipment**.

Raceway, Metal: **Rigid** and **flexible conduit**, **wireways**, and **surface raceways**, such as metal mouldings, also **metal under-floor raceways**.

Raceway, Surface: A metal channel consisting of a backing and capping for loosely holding **conductors** and cables in surface wiring.

Raceway, Underfloor: A channel or duct of metal or other suitable material, designed and **approved** for use under floors, into which it is intended that **conductors** shall be drawn. This term is not applied to **metal conduit**, tile or other like ducts.

Readily Accessible: Able to be reached quickly and without climbing over, or removing, obstructions; or resorting, for example, to chair, box, or portable ladder. (See **Accessible**.)

Receptacle:—A device constructed for permanent mounting, into which may be inserted a detachable cap or plug.

Repellant: A term to which the word "moisture" is prefixed to describe the property of material (such as wax or varnish) from the surface of which water will tend to run off and through which it cannot readily penetrate.

Resisting: Able to resist any undesirable effect of absorption, moisture, heat, etc., according as the prefix used indicates, (e.g. absorption-resisting, heat-resisting, etc.), to a degree sufficient to ensure proper operation under the conditions liable to be encountered.

Retarding: A term used in the expression “**flame-retarding**”, to indicate that the material to which the expression is applied neither will burn for more than a specified period of time nor will the flame travel or extend beyond a specified distance.

Note: The use of the expression “flame-retarding” is practically confined to the coverings of wires and cables.

Rigid Conduit: **Approved conduit**, suitable for threading with standard pipe-thread, into which it is intended that **conductors** shall be drawn.

Service, Consumer’s: All that portion of the consumer’s installation from the **service box** or its equivalent, up to and including the point at which the **Supply Authority** makes connection.

Service, Supply: Any one set of **conductors** run by a **Supply Authority** from its mains to a **consumer’s service**.

Service Box: An **approved** assembly consisting of a metal box or **cabinet** so constructed that it may be effectually locked or sealed, containing either **service** fuses and a **service switch** or a **circuit-breaker**, and of such design that either the **switch** or **circuit-breaker** may be manually operated when the box is closed.

Service or Filling Station: A **building** or portion of a **building** within which are installed pumps or other devices used for the purpose of receiving or delivering volatile **flammable** liquids to or from vehicles.

Slow-burning: See the definition of “**Retarding**”. These terms are practically interchangeable.

Solder: (To), To unite two metallic surfaces by the fusion thereon of a metallic alloy, usually composed of lead and tin.

Note: This definition purposely excludes those so-called solders which consist of a metallic powder mixed with an adhesive vehicle, in the use of which fusion of a metal is not involved.

Special Permission: The written authority of the **Inspection Department**.

Supply Authority: Any person, firm, corporation, company, commission or other organization supplying electric energy.

Surface-raceway: See **Raceway: Surface**.

Switch: A device for making, breaking, or changing connections in a circuit.

Switchboard: A panel or assembly of panels on which are mounted any combination of switching, measuring, control, and protective devices, **buses**, and connections, designed with a view to successfully carrying and rupturing the maximum fault currents encountered when controlling incoming and outgoing **feeders**. (See also **Industrial Control Board**; **Panelboard**; and **Panelboard: Enclosed**.)

System: An electrical system in which all the **conductors** and apparatus are designedly capable of being readily electrically connected by *metallic contact* to a common source of potential difference.

System: Communication, An electrical system used either for transmitting intelligence, including telephone, telegraph-messenger, etc., or for protective purposes such as fire-alarm, burglar-alarm, etc., but not including communication systems carried on by radio.

Note: For Classification of Communication Circuits see Section 60.

Theatre: A **building**, or any portion thereof, which is licensed to be used for public dramatic, operatic, motion picture, or other public performances.

Thermal Cut-out: A device affording over-current but not necessarily short-circuit protection, and containing a heating element in addition to, and affecting, a fusible member which opens the circuit.

Underfloor Raceway: See **Raceway, Underfloor**.

U.S. Sheet-metal Gauge: The United States' Standard Gauge for sheet metal (Iron and steel).

Voltage to Ground:

- (a) In **grounded** circuits: The voltage between any given **live ungrounded** part and any **grounded** part.
- (b) In **ungrounded circuits**: The greatest difference of potential existing in the circuit.

Waterproof: So constructed or protected that moisture cannot enter in quantity sufficient to interfere with the effectiveness of the equipment so designated.

Water-tight: So constructed that moisture cannot enter the enclosing case.

Wireway: **Approved** steel troughing, and fittings therefor, so formed and constructed that **insulated conductors** may be readily drawn in and withdrawn, or laid in and removed, without injury either to **conductor** or covering.

SPECIAL DEFINITION

Shockproof: See "X-ray and High-frequency Installations"—Rule 5101 (a).

SECTION 2—GENERAL RULES

Note: Rules 201, 207, 208 and 209 are inserted for the guidance of governing authorities.

Rule 201

Authority for Rules and Permission for Deviation Therefrom

- (a) By virtue of the authority vested in the **Inspection Department** this Code has been approved and the **Inspection Department** hereby orders and directs its observance.
- (b) In any case where deviation from or postponement of these Rules and Regulations may be necessary, such deviation or postponement shall not be made except by **special permission**.

Rule 202

Protection

- (a) **Electrical equipment** shall be so installed and **guarded** that adequate provision is made for the safety of persons and property and that it is itself adequately protected from mechanical or other injury wherever it is likely to be exposed thereto.
- (b) Owners of factories, workshops, or of any premises where employees are engaged in operating or using any **electrical equipment**, shall keep the entire electrical installation in safe operating condition, in accordance with Section 70 "Maintenance and Operation."

Rule 203

Equipment and Workmanship

- (a) **Electrical equipment** used in electrical installations within the jurisdiction of the **Inspection Department** shall be **approved** and shall be of a kind or type, and rating, **approved** for the specific purpose for which it is to be employed. (See also Rules 2001(b), 2002(e) and 2003(i)).
- (b) The maker's name, trade-mark or other recognized symbol of **identification** shall be placed on **electrical equipment** together with such other markings giving voltage, current, wattage and other appropriate ratings as are prescribed by the C.E.S.A. Each unit of **electrical equipment** shall bear evidence that it has been **approved**. (See definition of the word "**Approved**".)

- (c) Any **electrical equipment** may be rejected at any time by the **Inspection Department**, even though **approval** has previously been given, if in the opinion of the **Inspection Department** it is sub-standard to the sample on which **approval** was granted, or if all the terms of the Approval Agreement are not being carried out.
- (d) In any case where, for a given purpose, no standard **electrical equipment** of the exact size or rating required is procurable, equipment of the next larger size or rating shall be used unless **special permission** is obtained to use equipment of a smaller size or rating.
- (e) In all electrical installations special attention shall be paid to the mechanical execution of the work. Careful and neat running, connecting, **soldering**, taping of **conductors**, and securing and attaching of equipment is required. Work badly arranged or poorly executed will not be **approved**.
- (f) Wood shall not be used for plugging for the support of any **electrical equipment**; **approved** plugging devices or material only shall be used.
- (g) Only non-corrosive **soldering** fluxes shall be used for **soldering** copper.

Rule 204

Overhauling Existing Installations

- (a) This Code refers generally to work to be performed. In the case of old installations, and of any other installations, where, through hard usage, wear and tear, or through alterations or extensions, dangerous conditions have developed, the **Inspection Department** may require such changes to be made as are necessary to remove these defects.

Rule 205

Interference of Other Work

- (a) No person shall render any electrical work **inaccessible**, by lathing, boarding or other building construction, until it has been approved by the **Inspection Department**.
- (b) No person shall cut, damage or interfere with any **electrical equipment**, or shall place or install any equipment or material so close to installed **electrical equipment** as to create a condition which, in the judgment of the **Inspection Department**, is dangerous.

- (c) If the hollow spaces in walls, floors, and roof spaces of **buildings**, which contain electric wiring, are to be filled with thermal insulation, except as provided below, only **approved** non-corrosive, **incombustible**, non-conducting materials shall be used, and these shall be applied in a manner not likely to place any strain upon the **conductors** or **raceways** or on their supports.

If such spaces be filled with combustible thermal insulation, wiring shall be in **rigid conduit**, or in **flexible conduit** with **conductors** in a lead sheath, or lead-sheathed **armoured cable** may be used.

- (d) **Contractors** shall place in some conspicuous position on their work a plainly legible notice, in a form prescribed by the **Inspection Department**, incorporating in full the intent of the two preceding Clauses (a) and (b).
- (e) Electrical installations shall be so made that the spread of fire through fire-stopped partitions, floors, hollow spaces, fire walls or fire partitions, vertical shafts, ventilating or air-conditioning ducts, is reduced to a minimum.

Raceways shall not be installed in ducts for dust, stock or vapour removal. If **raceways** be installed in air-conditioning ducts or plenum chambers, then the wiring method shall be **rigid conduit** with fittings suitable for the location. **Raceways** shall not interfere with the operation of automatic fire dampers in ducts.

Rule 206

Special Installations and Equipment

- (a) Potentials exceeding 15,000 volts shall not be employed without **special permission**.

Note: Such permission is not necessary in the case of apparatus for which special rules are provided in this Code (e.g. luminous discharge-tube installation.)

- (b) Sections devoted to rules governing installation in special "occupancies", such as those in **theatres, garages, elevators, cranes, hazardous locations, high potential installations**, etc., are not intended to embody all rules governing this particular class of work, but cover only those special rules or regulations which are additional to or amendatory of those prescribed in other Sections covering similar work under **ordinary conditions**.

Rule 207

Plans and Specifications

- (a) The installation of generators, storage-battery plants, large **switchboards**, transformers, transformer vaults, etc., and in general, large power and lighting installations, shall not be commenced until complete wiring plans and specifications *in duplicate*, have been submitted to the **Inspection Department** by the owner or his agent, and approval obtained therefor. One copy which has been approved will be retained by the **Inspection Department**.
- (b) In the case of all **buildings** such as **theatres**, schools, churches, apartment-houses, stores, **industrial establishments**, factories and other places in which public safety is involved, plans and specifications shall be submitted for approval.

Note: In the case of private residences, and small buildings generally, where the possibility of menace to public safety is not serious, the submitting of plans is optional, unless specifically requested by the Inspection Department.

Rule 208

Permits and Applications for Inspection

- (a) **Contractors** about to carry out any installation work, alterations, repairs, or extensions, shall, before the work is commenced, obtain a **permit**, and file an application for inspection on forms provided by the **Inspection Department**. At the same time, the fees for both **permit** and inspection shall be paid; the amount being in accordance with the schedule prescribed by the **Inspection Department**.
- (b) **Contractors** shall, at such time as will permit of inspection being made before any work or portion thereof is liable to be **concealed**, notify the **Inspection Department**, in writing, that work is ready for inspection.
- (c) A copy of the **permit** shall be posted on the site of the work in a conspicuous place and shall not be removed until final inspection has been completed.

Rule 269

Current-permits

- (a) No installation, alteration, or addition shall be connected or re-connected to any **service** or other source of electric energy by a **Supply Authority**, **Contractor**, or other person, until a **current-permit** authorizing the supply of electric energy thereto has been obtained from the **Inspection Department**.

- (b) **Current-permits** shall not be required for re-connection by a **Supply Authority** in cases where the **service** has been cut off for non-payment of bills nor in cases where there has been merely a change of occupant.

*Note: Any change in the installation is covered by "Permits and Applications for Inspection"—Rule 208(a), the proper observance of which will safeguard the question of alterations made after the disconnection of a **service**.*

*The **Inspection Department**, however, reserves the right to re-inspect any installation if and when it considers such action to be necessary.*

Rule 210

Considerations affecting Approval

Note: This Rule is primarily for field use.

- (a) **Electrical equipment** designed for use under this Code shall be judged chiefly with reference to the following five considerations, which determine also the classification by types, sizes, voltages, current-capacities and specific uses.
- (1) Suitability for installation and use in conformity with the requirements of this Code.
 - (2) Mechanical strength and durability, including, for parts designed to enclose and protect other equipment the adequacy of the protection thus provided.
 - (3) **Electrical insulation.**
 - (4) Heating effects under normal conditions of use and also under such abnormal conditions as are liable to arise in service.
 - (5) Arcing effects.
- (b) Bases for the mounting of **live** parts shall be composed of **incombustible absorption-resisting insulating** material, which may include slate, soapstone or marble, and the design shall be such that, considering the material used, the base will withstand the most severe conditions liable to arise in service. Holes for the supporting-screws shall be countersunk, or shall be so located, that there will be at least $\frac{1}{2}$ in. measured over the surface, between the screw head or washer and the nearest **live** metal part. In all cases where the screw head or washer is located between parts of opposite polarity, it shall be countersunk. If practicable, nuts or screw heads on the underside of the base shall be countersunk, and sealed with an **insulating waterproof** compound.

- (c) Terminal parts, by means of which connections are made, shall ensure thoroughly good connection even under hard usage. For currents above 35 amperes, lugs into which the **conductors** may be **soldered**, or solderless connectors shall be provided. For currents of 35 amperes or less the parts to which wiring connections are made shall securely grip the **conductors**. Suitable clamps or screws, with terminal plates having upturned lugs, or solderless connectors, may be used.

Note: Lugs or clamps are not required when leads are provided as part of a device.

- (d) The following devices, in sizes rated at 30 amperes or less, any terminals or leads of which are intended to be connected to a **grounded conductor** or to the **neutral conductor** of a 3-wire d.c. or single-phase a.c. circuit, shall have such terminals or leads **identified**, unless the fact that they are intended for connection to such a **conductor** is otherwise clearly evident.

(1) **Over-current devices** (multipole).

(2) Polarised **receptacles** and plugs.

(3) **Lampholders**.

- (e) In **lampholders**, the **identified** terminal shall be the one connected to the screw shell.

- (f) **Identification** of terminals shall be accomplished as follows:

(1) By plating them with a metal substantially white in colour, such as nickel or zinc, or

(2) By making them of metal substantially white in colour.

The other terminals shall be of a colour readily distinguishable from that of the **identified** terminals.

- (g) **Identified** leads shall have a white or natural gray covering, the colour of the other leads being readily distinguishable therefrom.

Note: See "Neutral Conductors"—Rule 603(d).

SECTION 4—SERVICES AND SERVICE EQUIPMENT

Rule 401

Installation of Services

General

(a) Except as provided below, one **supply service** only of the same potential and characteristics shall be run to any **building** from the same **system** of any one **Supply Authority**.

(1) If a separate **service** be required for fire pumps or **emergency lighting** purposes.

(2) Where, on account of **buildings** of large area, unusually large loads are involved, the **Inspection Department** has by **special permission** authorized an additional **service**.

Where multiple **services** are to be installed the electrical characteristics of each **service** shall be plainly indicated in a legible and permanent manner and the **service** equipments shall be grouped if practicable.

(b) **Conductors** run aërially from one **building** to another or to any other structure, may be "open" **conductors** not less than No. 10 **B. and S. Gauge** or by **special permission** they may be in the form of a multiple-conductor cable **approved** for the purpose.

(c) If **service conductors** from a pole-line to a **building** be run underground, lead-covered cable shall be used from a point up the pole 20 ft. above the ground, to the **building**, and the cable shall be protected against mechanical injury. If **rigid conduit** or other form of duct be used to protect **service conductors** entering a **building** underground it shall be suitably drained towards the **building**. Ducts shall, where necessary, be sealed against the entrance of flammable gases.

(d) A **supply service** shall not be run to a **building** from an electric railway system using a **ground** return.

Note: This is not intended to conflict with special rules regarding electric-railway cars, car-houses, or passenger and freight stations connected with the operation of electric railways.

(e) The supply end of each **conductor** of a **consumer's service** shall extend at least 30 in. beyond the supply end of the **consumer's service conduit**, or duct, in which it is

run, so that connection of the **supply service** may be readily made to these **conductors**.

The same minimum length of spare **conductor** shall be left as "meter loops".

- (f) The point at which a **consumer's service**, whether overhead or underground, enters a **building** shall be subject to the approval of the **Inspection Department** and shall be at a location satisfactory to the **Supply Authority**.

Rule 402

Service Conductors and Conduit

For "High-potential Installations"—See Rule 5002.

General

- (a) **Service conduit** shall have an internal diameter of not less than $\frac{3}{4}$ in. electrical trade size, and shall contain no other than **service conductors** and only the **conductors** of one **service**. The supply end of **consumer's service conduit** shall be provided with a weatherproof **service fitting**.
- (b) The supply end of a **consumer's service conduit fitting** shall, subject to the approval of the **Inspection Authority**, be installed in a location satisfactory to the **Supply Authority** and shall be located not less than 18 ft. nor more than 30 ft. above sidewalk or ground level. In the case of low **buildings** where 18 ft. height is not obtainable the **service head** shall be as high as practicable and may by **special permission** be placed at a lower level, but in no case less than 9 ft. above sidewalk or ground level.
- (c) **Service-entrance cables** shall be equipped with an **approved rain-tight service head** or be formed into a gooseneck the **conductors** being taped and painted. In both cases drip loops shall be formed on each **conductor** and ample lengths left available for splicing.
- (d) **Service conductors**, if lead-sheathed, shall at their points of issue from the lead-sheathing, be protected from moisture by pot-heads or equivalent **approved devices**.
- (e) **Consumers' service conductors** shall conform to the requirements of Section 6 except that no **service conductor** shall have a current-carrying capacity less than that of No. 10 **B. & S. Gauge** copper wire.
- If an electric range is to be installed, the *minimum* size of **conductors** used shall be No. 6 and No. 8 **B. & S. Gauge** for 2 and 3 wire **consumer's services** respectively.

Low Potential

(For “*Electrical Communication Systems*”—See Rule 6004(h)).

- (f) **Conductors** of a **consumer’s service** connected to an overhead **supply service** at any point on a **building**, above ground, shall be run in one or other of the following ways:
- (1) In **rigid conduit**.
 - (2) In **flexible conduit**, the **conductors** being lead-sheathed.
 - (3) **Armoured-cable**, the **conductors** being lead-sheathed.
 - (4) Cable specially **approved** for **service** entrance work, and used only by **special permission**, having a **flame-retarding, absorption-resisting** covering and—
 - (i) Protection against mechanical injury; (**Armoured Service Entrance cable**, i.e. Type A.S.E.
 - or
 - (ii) No inherent protection against mechanical injury, but, when used, protected by **conduit** or other approved means where within 7 ft. of the ground, or where subject to mechanical disturbance. (service entrance cable i.e. Type S.E.—styles A, U, UR.) Such cable shall not be used for potentials exceeding 300 volts between **conductors** and 150 volts to ground. Cable shall be supported at intervals not exceeding 5 ft. Cables having metal **armour** (Type A.S.E. **armoured cable**) may be mounted in contact with the wall; other types (Type S.E. service entrance) shall, when run on combustible or conducting surfaces, be mounted on insulating supports which hold them at least 2 in. from such surface.
- (g) That portion of **service conductors** on the supply side of the **service-head** may be run outside along walls of **buildings** and such **conductors** shall be run as open-wiring; or in **rigid conduit**; or in **flexible conduit** (the **conductors** being lead-sheathed); or lead-sheathed **armoured-cable** shall be used; or cable or **conductors** without lead-sheathing, specially designed and **approved** for **service** work, may be used by **special permission**.

Such portion, if run as open-wiring, shall consist of single **conductors** having either a weatherproof covering or rubber **insulation**.

- (h) The **neutral conductor** of a **consumer's service** may by **special permission** be bare, subject to the following conditions:
- (1) That the supply is single-phase a.c. and of less than 150 **volts to ground**.
 - (2) That the **neutral** of the supply **system** is **grounded** to a **metallic-water-piping-system ground** irrespective of any **grounds** made at **consumer's services**.
 - (3) That the bare **neutral** is run in the same protective **conduit** or **armouring** as the other **conductors** of the **service**.
- (i) The current-carrying capacity of bare **neutral conductors** shall be based on Column C of Table VII and the ampere rating, on this basis, shall be not less than that of the rubber-covered **conductors** of the same circuit and in no case less than No. 10 **B. & S. Gauge**. (See Column A of Table VII).

Rule 403

Location of Service Equipment

General

- (a) **Service boxes**, or their equivalent, shall, subject to the approval of the **Inspection Authority**, be installed in a location satisfactory to the **Supply Authority** and shall be **readily accessible** and shall not be located in coal-bins, clothes-closets, bathrooms, dangerous or **hazardous** locations, except as permitted in Section 32. In general, they shall be placed within the **building** and as close as practicable to the point where the **service conductors** enter the **building**. A **service box** may, by **special permission**, be placed on the outside of a **building**, or in the rural districts, where, as on a farm, a group of **buildings** is to be served, the box may be placed on a pole, provided that it be so located or protected that it will neither be liable to suffer mechanical injury nor be harmed by the weather. In such cases no part of the **service box** shall be less than 6 ft. above the ground or floor directly below it, but either the box or the means of operating it shall be **readily accessible**.

Rule 404 Control and Protective Equipment

General

(See Rule 5003)

- (a) Except as provided below, every electric **service** shall be furnished either with a **service box** or with other **approved service** equipment so located and installed as to constitute an equivalent. (See also Rule 3911(d) and 4001(b)).

Exceptions—The **service box** or other **approved** equipment may be omitted if all the following conditions are complied with.

- (1) That **approved circuit-breakers** are used in each **branch-circuit** and these are grouped in a **readily accessible cabinet** at the point of **service** entrance.
- (2) That the **circuit-breakers** are operable from without the **cabinet**.
- (3) That the supply is a.c. and does not exceed **150 volts to ground**.
- (4) That the total connected load does not exceed 100 amperes at either 150 or 300 volts.
- (5) That the meter is connected on the supply side of the **branch-circuit breakers** and that no **live** parts or wiring are **exposed**.

Under the conditions provided for in these Exceptions, two single-pole, manually operable **circuit-breakers** may be used on 3-wire **branch-circuits** having one **conductor grounded**, provided that they are so connected together that, when operated manually, they will conform to the requirements of Rule 701(a).

- (b) **Service boxes** shall conform to the requirements of Sections 7 and 8 except that no single-pole **switch** or **circuit-breaker** shall be used on any 3-wire **service**, and means, such as a removable link, shall be provided within the **service-box** or with its equivalent, whereby the **neutral** or the **grounded conductor** may be conveniently disconnected.
- (c) Except on **switchboards**, **service switches** shall be of the externally-operable type.
- (d) Except as provided below, **over-current devices** and meters shall be connected on the load side of the **service-box** or other **approved service** equipment.
Exceptions. The meter may be connected on the supply side if all the following conditions be complied with.

- (1) That no **live** parts or wiring are **exposed**.
 - (2) That the circuit is a.c. and the potential does not exceed 300 volts between **conductors**.
 - (3) That the rating of the **service-box** or other **approved service** equipment, does not exceed 100 amperes.
- (e) If oil-**switches** or oil **circuit-breakers** be used as **service switches, isolating switches** shall be installed on the supply side thereof.
- In the case of metal-clad equipment the primary isolating device shall be considered to be the equivalent of an **isolating-switch** or isolating link.
- (f) If a **service** supply one **branch-circuit** only and the **service box** containing a fuse or fuses is to be locked or sealed, **over-current devices accessible** to the consumer shall be inserted in series with the **service over-current devices** and on the load side of the meter, but they shall be of smaller current-carrying capacity than the **service over-current devices**.
- (g) In any case where an installation, or portion thereof, is to be supplied with current from two or more different sources, the switching equipment controlling the various supplies shall be so constructed or arranged that it will be impossible for any one accidentally to switch on current from one source before that from another has been cut off.
- (h) **Service boxes** shall, if required by the proper authority, be sealed or locked by the **Supply Authority** and shall not then be opened except by an **Inspector** or by an authorized agent of the **Supply Authority**.
- (i) A **low-potential** two, or three-phase **consumer's service** may be sub-divided into single-phase sub-services.
- (j) In multiple occupancy and in single occupancy multi-rate **service**, a separate **service box** shall be provided for each sub-division of the main **service**. If the potential does not exceed 150 **volts to ground** and if such (sub) **service boxes** are in a common enclosure or in separate enclosures grouped at a **readily accessible** point as close as practicable to the point of entrance of the **service conductors**, no main **service box** need be provided unless such (sub) **service boxes** exceed 6 in number. Where it is not the practice of the **Supply Authority** to seal the service entrance equipment (including **service switch** and troughing enclosing bus bars) a suitable disconnect shall be installed on the supply side in each **ungrounded line conductor** as close as possible to the service equipment.

- (k) If two or more **switches** be banked at a **service** entrance, or at a distribution centre, **auxiliary gutters** or some approved equivalent shall be employed to enclose the wiring between **switches**. If such gutters or equivalent be employed, the following requirements shall be met:
- (1) The gutter or equivalent shall be equipped with terminal blocks to which the wires feeding the individual **switches** may be connected.
 - (2) If the gutter or equivalent be more than 6 ft. long, continuous busbars shall be provided in lieu of the terminal blocks.

*Note: The banking of **switches** is not allowed in the case of **service** entrances or distribution centres of a greater capacity than 600 amperes each; in the latter case oil-**switches** or **circuit-breakers** shall be used. (See Rule 702(b)).*

- (l) If there be more **service boxes**, or meters, than one, each such box, or meter, shall be labelled in a conspicuous, legible and permanent manner to indicate clearly which installation or portion of an installation it controls.
- (m) In multiple occupancy **buildings** where individual metering is required each tenant's supply shall be provided with separate sealable **service** equipment or a metering panel which shall be clearly identified. If there is more than one **circuit-breaker** the same shall be clearly identified to the satisfaction of the **Inspection Department**.
- (n) If a **service box** embody one or more fuse receptacles access to which may be had without opening the door, such receptacles and their fuses shall be completely enclosed by a separate door having a substantial catch.
- (o) **Neutral conductors** of **branch-circuits** shall be connected to those terminals on the **neutral** block that correspond to the terminals to which the line **conductors** of the same circuits are connected.

Rule 405

Meters

General

Note: A meter is to be considered as including any current and potential transformers used in conjunction therewith.

- (a) Meters shall be located as near as practicable to the **service box** and, except for meter loops (See Rule 401(e)), that portion of the **service conductors** between the meter and the **service box** shall be rendered **inaccessible** to unauthorized persons.

Where practicable, meters shall be grouped.

Note: See "Use of **Rigid and Flexible Conduit and Armoured-cable**"—Rule 507(a) (8).

- (b) Meters and metering equipment shall, subject to the approval of the **Inspection Department**, be installed in locations satisfactory to the **Supply Authority** and shall be **readily accessible** from the ground or floor directly below them for reading and inspection, and shall not be located in coal bins, clothes closets, bathrooms, stairways, dangerous or **hazardous** locations, except as provided for in Section 32, nor in any similarly undesirable places.

A vertical space of not less than 15 in. and a horizontal space of not less than 12 in. or additional space, if required by the **Supply Authority** shall be left for installation of the meter, unless **special permission** be granted to do otherwise.

In the case of commercial buildings, the following minimum space shall be provided for metering purposes: 12 in. wide, 22 in. high, with a depth of 9 in.

If mounted outdoors they shall either be of weatherproof construction or shall be in weatherproof enclosures.

Note: For locations exposed to rain or moisture, see Section 34.

- (c) Instrument transformers used in connection with meters shall be installed in **approved** metal enclosures except when mounted on **switchboards** or in transformer vaults or otherwise rendered **inaccessible** to **unauthorized persons**.
- (d) For meters not mounted on **switchboards**, either a suitable panel, fitting, or **service boxes** with meter back-plates, shall be provided on which the meter and other **service** equipment shall be mounted.

SECTION 5—WIRING METHODS—LOW POTENTIAL

Rule 501

General

- (a) **Conductors** for use under **ordinary conditions** shall be of one or other of the types specified in Table I and shall not be exposed to temperatures exceeding those specified therein.

TABLE I

TEMPERATURE LIMITS OF SURROUNDING AIR FOR VARIOUS TYPES OF INSULATED CONDUCTORS

Conductors		Maximum Allowable Temperature	
Designation	Type	Deg. C	Deg. F.
Rubber-covered	R	50	122
Varnished-cloth Insulated	VC	75	167
Slow-burning Weatherproof	SBW	90	194
Slow-burning	SB	90	194
Asbestos-covered	A-etc.	Over 90	Over 194

Note: Approved rubber insulations suitable for use at specified maximum temperatures exceeding 50 deg. C. may be used for certain specified purposes for which they are approved.

- (b) **Conductors** located in **damp places** shall be of the rubber-covered type. **Conductors** subjected to corrosive action shall be of the weatherproof (WP), varnished-cloth (VC), or rubber-covered (R) Type, as may be directed by the **Inspection Department**.
- (c) **Conductors**, not held in place by other means permitted by these Rules, shall be supported on **incombustible, absorption-resisting insulators**.
- (d) Split knobs shall not be used to support **conductors** larger than No. 8 B. & S. Gauge.
- (e) **Conductors** supported on solid knobs shall be securely tied thereto and the **insulation** on tie wires shall be of the same type as that on the **conductors** which they secure.

- (f) Either solid knobs or strain **insulators** shall be used, at the ends of runs, for **conductors** of No. 8 **B. & S. Gauge** or larger.
- (g) Knobs and cleats shall be securely fastened with screws.
- (h) Open wiring, if supported on the faces of joists, wall-studs, or other timber, or on walls in locations where it would be exposed to mechanical injury, shall be protected by running-boards, guard-strips, wooden boxing or sleeves of iron pipe.

Note: Conductors, of not less than No. 8 B. & S. Gauge, separated not less than 6 in. may be run directly from timber to timber and supported at each timber only if not subjected to mechanical injury.

Open wiring shall not be run across the tops of ceiling joists in unfinished attics or like places.

Conductors, or portions thereof, which are less than 7 ft. above the floor, shall be considered as being exposed to mechanical injury.

Material for running-boards, guard-strips and boxing, shall be not less than $\frac{7}{8}$ in. thick, and the edges of running-boards shall be at least $\frac{1}{2}$ in. beyond the **insulators** on both sides.

Guard-strips shall be at least as high as the **insulators**, and placed as close to the **conductors** as these Rules permit. In wooden boxing there shall be a clear space of not less than 1 in. between **conductors** and adjacent surfaces, and ends of boxing not abutting on the structure of the **building** shall be closed.

- (i) If **conductors** are to be installed in **hoistways**, they shall be run in either **rigid** or **flexible conduit**. **High-potential conductors** shall not be installed in such **hoistways**. (See Section 31).
- (j) **Insulated conductors**, if closely grouped, as in the rear of **switchboards**, shall have a substantial flame-retarding covering.

If the **insulation** on a **conductor** has a flame-retarding coating or covering this coating or covering shall, at all terminals and splices, be removed sufficiently to effectually prevent creepage of current over it.

Note: See "Conductors and Conduit"—Rule 3102(i).

(k) **Conductors** between generators, transformers, **switch-boards**, and other apparatus used in connection therewith, shall either be exposed to view and supported on **incombustible, absorption-resisting insulators**, or they shall be run in **conduit**, tile or other fireproof duct, or **armoured-cable** shall be used.

(l) If **conduit** or ducts are to be so located that moisture is liable to accumulate therein, the **conductors** shall be lead-covered. A pot-head or equivalent device shall be used to protect the **conductors** from moisture and mechanical injury where they issue from the lead-sheathing.

Note: See Section 34.

(m) The radii of all bends in **conductors** shall be sufficiently large to ensure that no injury will be done either to the **conductors** or their **insulation**, covering, or sheathing.

Note: See Rule 504 (k).

(n) Holes in outer walls through which **conduit** or duct passes shall be made water-tight in a permanent and effective manner, and the openings in such **conduit** or duct, if underground, shall be made **gas-tight** if this be required by the **Inspection Department**.

(o) If not exposed to mechanical injury, **conductors**, where passing through walls, floors, timbers, or partitions, shall each be bushed with a porcelain tube which shall be continuous throughout its length and which shall project at least $\frac{1}{2}$ in. beyond the finished surfaces from which it issues. In locations where porcelain bushings would be exposed to mechanical injury, all the **conductors** of a circuit shall be bushed with a single sleeve of iron pipe, and each **conductor** shall be separately encased in a continuous length of **flexible tubing** extending the full distance between the **insulators** next adjacent to the ends of the bushing.

(p) If **conductors** approach at any point within 2 in. either of other **electrical conductors**, or of metallic piping or other conducting material, they shall, at such points, be protected by porcelain tubes, or by **flexible tubing**, firmly fixed in place.

In **damp places** either porcelain tubes shall be used or there shall be an air-space of not less than 1 in. between the **flexible tubing** and wet or other conducting surfaces.

- (q) If lightning-**conductors** be installed on a **building**, electric wiring and metal **conduit** shall, if practicable, be kept at least 8 ft. from such **conductors**. If this be not practicable they shall be bonded together.
- (r) Joints or splices in **insulated conductors**, unless made with solderless connectors, shall be **soldered**, but shall first be made both mechanically and electrically secure. Joints or splices shall be covered with an **insulation** equivalent to that on the **conductors** joined. Ends of **insulated conductors** (e.g., those at **switch** and fixture **outlets**), if not in use, shall be **insulated** as required for joints. Except for open, and knob and tube wiring, wiring connection shall be in **boxes**, or enclosures of **incombustible** material.
- (s) Stranded **conductors**, except in flexible cords, shall be **soldered** before being fastened under the heads of terminal binding screws. Stranded and solid **conductors** of greater current-carrying capacity than No. 8 B. & S. **Gauge** copper shall be **soldered** into lugs at terminals unless solderless connectors be used.
- (t) **Conductors** shall be so supported that no injurious strain will be imposed on the terminals of apparatus, devices, etc., nor on any joints or taps.

Rule 502

Open Wiring

Note: See Rule 501, Section 34 and Rule 6001.

- (a) **Conductors** shall meet the requirements specified in Table I.
- (b) **Conductors** shall be rigidly supported, and in normally dry places the separation specified in the following Table shall be maintained throughout.

TABLE II
SPACINGS FOR CONDUCTORS

Voltage of Circuit	Minimum Distance Inches	
	Between Conductors	From Adjacent Surfaces
0—300	2½	1½
301—750	4	1

If circuits of different voltages be run parallel to each other the separation between adjacent **conductors** of the different circuits shall be at least equal to that between the **conductors** of the circuit of higher voltage.

In **damp places** a separation of at least 1 in. from adjacent surfaces shall be maintained.

- (c) **Conductors** run on flat surfaces shall be rigidly supported at intervals not greater than $4\frac{1}{2}$ ft.
- (d) **Conductors** shall not be *dead-ended* at any fitting which is more than 12 in. from their last supporting **insulator**.
- (e) Sub-bases shall be installed under all snap-**switches** and **receptacles**.
- (f) Where there is a connection of open wiring to **conductors** in **raceways**, **armoured-cable** or non-metallic sheathed cable, the junction shall be made in a box, or at or in a fitting having separately bushed holes for each **conductor**. (See Rule 510 (c)).
- (g) If iron pipe sleeves be used for the mechanical protection of **conductors**, all the wires of any one circuit shall be run in one sleeve, and each wire shall be separately enclosed in **flexible tubing** extending in a continuous length the entire distance between the **insulators** adjacent to the ends of the sleeve.

The iron sleeve shall be well secured in place and shall extend at least $\frac{1}{2}$ in. beyond the finished surfaces from which it issues.

Rule 503

Knob-and-tube Work

Note: For grounding of outlet, switch and receptacle boxes, see "Exposed Non-current-carrying Metal Parts"—Rule 904 (a)(5).

- (a) Knob-and-tube work shall not be used for potentials exceeding 150 volts to ground, and/or 300 volts between any two **conductors**.
- (b) **Conductors** shall be of the rubber-covered (R) Type.
- (c) **Conductors** shall be separately supported on **incombustible, absorption-resisting insulators**. A separation of at least 4 in. between **conductors**, and at least 1 in. from all adjacent surfaces, shall be maintained. At distribution centres, meters, **outlets, switches** and at any other places where 4-in. separation cannot be maintained, each **conductor** shall be encased in a continuous length of **flexible tubing** extending from within the **outlet** box, etc., to the nearest supporting knob.

- (d) **Conductors**, where practicable, shall be run singly on separate timbers or studding and shall be rigidly supported at intervals not greater than $4\frac{1}{2}$ ft.
- (e) If **conductors** pass through, or near to, cross timbers in spaces behind plastering, any portion of the **conductor** which is within a vertical distance of 3 in. above the upper surface of the cross timbers shall be protected by porcelain tubes.
- (f) If in any portion of an installation it be impracticable to employ **insulating** supports, the **conductors** shall, if exposed to moisture, be run either in **conduit**, or lead-sheathed **armoured-cable**. If **conduit** be used, the **conductors** shall be of the lead-covered rubber-covered type. If the **conductors** be not **exposed** to moisture they may be run separately in **flexible tubing** extending in continuous lengths from one support to the next, or to an **outlet**, or from one **outlet** to another; in this case the **conductors** may be fished.

Note: See "Armoured-cable Work"—Rule 506.

- (g) There shall be no joints or splices, in the **conductors**, within **flexible tubing**. Where there is a connection of knob-and-tube wiring to **conductors** in **raceways**, **armoured-cable**, or non-metallic sheathed cable, the junction shall be made in a box, or at or in a fitting having separately bushed holes for each **conductor**. (*See Rule 504 (f).*)

Rule 504

Raceway and Armoured-cable Work

General

Note: Raceways include Metal Conduit — Flexible and Rigid; and Surface and Under-floor Raceways, Gutters, Wireways, and Busways.

- (a) **Raceways** and the **armouring** and lead-sheathing of cables shall be electrically and mechanically continuous throughout.
Raceways and fittings having conductive coatings shall be used, unless **special permission** be granted for the use of enamelled material.
- (b) **Raceways** and the **armouring** of cable shall be mechanically and electrically secured to all **cabinets** and fittings to which they are attached and bushings shall be used to protect the **conductors** from abrasion.

If electrical continuity be not secured by clean, threaded joints, or by the use of two locknuts or by some other approved equivalent form of joint, bonding jumpers shall be employed.

- (c) **Raceways** and the **armouring** of cable shall be supported independently of all **cabinets** and fittings which form part of the **raceway** or **armoured-cable** system.
- (d) Fins and burrs shall be removed from the ends of **raceways** to prevent injury to the **conductors**.
- (e) Pull-in, junction and **outlet** boxes, **cabinets** and gutters, as well as all joints in wires and cables, shall be **accessible**.
- (f) **Conductors**, where they issue from the ends of **raceways**, or from **armouring**, shall be protected with **approved** boxes, or fittings having separately bushed holes for each **conductor** ((See Rule 510(c)).
- (g) **Conductors** shall, for **ordinary conditions**, be of the rubber-covered (R) Type. In normally dry locations the varnished-cloth **insulated** (VC) Type may also be used. They shall not be exposed to temperatures exceeding those specified in Table I.
- (h) If **conductors** of larger size than No. 8 **B. & S. Gauge** be necessary, only those having a double braid or a tape and braid shall be used.
- (i) All **conductors** of No. 6 **B. & S. Gauge** or larger shall be stranded.
- (j) All the **conductors** of a circuit shall be contained in the same **raceway** (or in the same channel of a multiple-channel **raceway**) or **armouring**. The same **raceway** (or channel), or **armouring** shall not contain circuits of **different systems**, and there shall be no joints or splices in **conductors** within the **raceway** or channel.
- (k) The radius of curvature of the inner edges of bends *made in the field*, in **raceways** of the draw-in type, and in **armoured cable**, shall be not less than 6 times the internal diameter of the **raceways** or **armouring**.
For **raceways** of the draw-in type and for **armoured-cable**, if lead-covered cables, or **conductors insulated** with varnished cambric, be used, the radius shall be not less than 10 times the internal diameter of the **raceway** or **armouring**.

Elbows and bends shall be made without undue distortion of the **raceway** or **armouring**, and without injury to either its inner or outer surfaces.

- (l) **Raceways** and **armoured-cable**, if to be laid in cinders, shall be protected from corrosive action by a grouting of concrete not less than 1 in. in thickness entirely surrounding the **raceway** or cable.
- (m) For **raceway** and **armoured-cable** wiring installed underground or in concrete slabs or other masonry in direct contact with moist earth or in other permanently moist locations where subject to condensation or moisture, the **conductors** shall be of the lead-covered type, or of other type specially **approved** for this purpose.

Rule 505

Rigid and Flexible Conduit Work.

(See "**Raceways and Armoured-cable Work**"—Rule 504).

- (a) No **conduit** smaller than 1/2 in. internal diameter, electrical trade size, shall be used.

Note: See "**Service Conductors and Conduit**"—Rule 402(a).

- (b) All **conduit** of the draw-in type shall be installed as a complete system before drawing in the **conductors**. If located in a **damp place**, only threaded **conduit** shall be used, and the joints and fittings shall be made water-tight.

Conductors shall not be drawn in until the mechanical work on the **building** reaches a stage where damage to the **conduit**, fittings or **conductors** is not likely to occur.

Note: See Section 34.

- (c) A run of **conduit** between **outlet** and **outlet**, or between any two draw-in points, shall not include more than the equivalent of 4 quarter-bends.
- (d) The size of **conduit** shall be such that the **conductors** can be both drawn and withdrawn without injury to the **conductors**.

Note: See Tables IX to XIII incl., Section 6.

- (e) **Conductors** in vertical **conduit** shall be supported at not more than the following intervals:—

TABLE III

SUPPORTING OF CONDUCTORS IN VERTICAL RUNS OF CONDUIT

Conductor Sizes	Maximum Distance Feet
No. 14 B. & S. G. to No. 0 B. & S. G.	100
00 to 0000	80
220,000 C. M. to 350,000 C. M.	60
350,001 to 500,000	50
500,001 to 750,000	40
Above 750,000 C. M.	35

*Note: Any suitable method of support may be used which, while maintaining the continuity of the **conduit** systems, does not injure either the cables or their covering.*

Rule 506

Armoured-cable Work

(See “**Raceway and Armoured-cable Work**”—Rule 504, and “**Neutral Conductors**”—Rule 603 (g).)

- (a) **Armoured-cable** shall be of lead-covered rubber-covered type if used for underground runs, and on other circuits if embedded in masonry, concrete or fill, in **buildings** in course of construction, and elsewhere if the location be such that the cable will be exposed to weather, continuous moisture, excessive humidity, or if exposed to oil, gasoline, or other materials having a deteriorating effect on rubber **insulation**.
- (b) **Approved** bushings of **insulating** material or other equivalent **approved** means, shall be provided at all points where **conductors** issue from the **armour**. The connector or clamp by means of which the **armoured-cable** is fastened to boxes or **cabinets** shall be of such design that the **insulating** bushing or its equivalent will be visible for inspection.
- (c) **Armoured-cable** shall not be *fished* when used in any **building** where **concealed** knob-and-tube wiring or **concealed** non-metallic sheathed cable wiring, is already installed, except in locations where it is evident that the existing wiring will suffer no damage.

- (d) Cable run through studs, joists or similar wood members, shall either be so located that the outer circumference will be not less than $1\frac{1}{4}$ in. from the edges of such wood members or else the cable shall be effectively protected from mechanical injury where passing through the holes.
- (e) **Armoured-cable** shall be securely held in place by **approved** fastenings spaced not more than 1 ft. from **boxes** or **fittings** and not more than $4\frac{1}{2}$ ft. apart unless *fished*.

Rule 507

Use of Rigid and Flexible Conduit and Armoured-cable

See also Rule 501 (k).

- (a) In all classes of work specified below, only **rigid conduit** or, by **special permission**, **flexible conduit**, or **armoured-cable**, shall be employed.

*Note: This will not prohibit the use of **surface raceways** or **armoured-cable** if (as, for example, in Rule 3901 (c)), their use be specifically allowed, nor will it prohibit the use of **underfloor raceways**.*

- (1) For wiring of stationary motors of $\frac{1}{2}$ H.P. and larger sizes, at 110 volts or more, except those in private residences.
- (2) Wiring in such **buildings** as are classed by local by-laws as being of **fire-proof** or of mill construction.
- (3) Wiring in hotels, private or public hospitals and asylums, in all churches, halls or other meeting places, etc., in which the floor area is 1200 sq. ft. or more, including aisles.
- (4) Wiring in educational institutions having two or more floors above the ground level, and all such **buildings** of four rooms or more.
- (5) Wiring in **theatres**, including moving-picture **theatres**.
- (6) **Consumer's service conductors**.

Note: For exceptions see Rules 402(f) (4), 5002 (k) and 6004 (h).

- (7) Wiring from distribution centres to electric signs located on, or attached to, **buildings**.
- (8) Wiring from **service boxes** to meters unless equivalent protection be provided.

- (9) Surface or concealed wiring where walls or ceilings are metal lathed or metal covered, unless the **conductors** be kept $1\frac{1}{2}$ in. from the metal, except at **outlets**. **Outlet** boxes shall be either of **insulating** material or, if of metal, they shall be **grounded**.

Note: See "Exposed Non-current-carrying Metal Parts"—Rule 904(a) (5).

- (10) Wiring for fire-escape lights and fire-gongs.

Rule 508

Surface Raceway Work

(See also "Raceway and Armoured-cable Work"—Rule 504 and "Rigid and Flexible Conduit Work"—Rule 505).

- (a) **Surface-raceways** shall not be used for circuits protected by **over-current devices**, rated, or set, at more than 30 amperes, and shall not be used where the potential exceeds 150 **volts to ground**. The total fusing of wires contained in single **service raceways** shall not exceed 60 amperes.
- (b) **Surface-raceways** shall not be **concealed** and shall not be installed in **damp places**.
- Note: For exception see "Underplaster Extensions"—Rule 509.*
- (c) Backing shall be secured in position by screws or bolts, the heads of which shall be flush with the metal.
- (d) **Surface raceways** shall not be used for **conductors** larger than No. 8 **B. & S. Gauge** nor for a number of **conductors** greater than that for which the **raceway** is **approved** and in no case for more than ten **conductors** except as otherwise permitted in this Code.

Note: See Sections 36 and 60.

- (e) **Surface-raceways** may be extended through a dry wall or partition, but no joints in the **raceway** itself shall be **concealed** within such wall or partition unless such wall or partition be constructed wholly of **incombustible** material. If a wall or partition be damp, or if the **raceway** pass through a floor, a sleeve of iron pipe shall be placed over the **raceway** and shall extend clear of either side of the wall, partition or floor.

If protection from mechanical injury be necessary a sleeve of iron pipe shall be employed.

- (f) Multiple-channel **surface-raceways** may be employed and may carry the **conductors** of **different systems** provided that each compartment contains only the **conductors** of one **system** and that the compartment allotted to each **system** maintains the same relative position throughout. The **systems** may include **communication systems**.

Rule 509

Under-plaster Extensions

- (a) Extensions of existing **branch-circuits** having **conductors** not larger than No. 10 B. & S. Gauge, may, in **buildings** of **fire-proof** construction, be laid on the face of the masonry or other materials of which the walls and ceiling are composed and buried in the plaster finish. Under-plaster extensions shall either be run in **metal raceways**, or **armoured-cable** shall be used. They shall comply with the rules covering the kind of material employed.

Rule 510

Non-metallic Sheathed Cable Work

(See “**Neutral Conductors**”—Rule 603).

*Note: In the following Clauses cross-references are made to Rules which require the use of **flexible tubing**. Such tubing is not required for non-metallic sheathed cable.*

- (a) Non-metallic sheathed cable shall not be used where the potential exceeds 300 volts between any two **conductors**.
- (b) The cable may be multiple-**conductor** assemblies in all **approved** sizes and may also contain an **uninsulated conductor** to be used for **grounding** purposes only.
- (c) The cable shall be run in continuous lengths from **outlet** box to **outlet** box (or junction boxes or panel boxes) as a “loop” system, all joints, splices and taps being made in the boxes.

If either **concealed** or open wiring be connected to **conductors** in **raceways** or **armoured cable** the junction shall be made in boxes, or at or in fittings having separately bushed holes for each **conductor**. (See also Rule 514(e).)

- (d) Bending and other handling of the cable shall be such that its covering is not injured.
- (e) The cable shall be secured between **outlets** by means of straps or other approved devices spaced at intervals not exceeding $4\frac{1}{2}$ ft., and also within 12 in. of every box or fitting. Straps if of iron or steel shall have a hot-dip galvanized finish and shall properly fit the cable.

- f) The cable shall not be buried in plaster, cement or similar finish.
- g) Cables in unfinished attics shall be run, supported, and protected, in the same manner as is required for that portion of the **building** which is to be completed; but in roof-spaces which will be permanently **inaccessible** and in which there are no gas or water pipes the cable will be considered as not exposed to mechanical injury and may therefore be run either through, or upon, the timbers.
- (h) Except as provided in the preceding Clause the cable will generally be considered as exposed to mechanical injury if it be run across the open faces of ceiling joists and shall under these conditions be installed as required by Rule 501, "General." In places where the possibility of mechanical injury is remote these requirements need not be observed.
- (i) Cable run through studs, joists or similar wood members, shall either be so located that its outer circumference will be not less than $1\frac{1}{4}$ in. from the edges of such wood members or else the cable shall be effectively protected from mechanical injury.
- (j) At **outlet** and other boxes the cable shall be rigidly fastened to such boxes by means of fittings which completely close the opening.
- (k) Boxes and fittings used shall be of types **approved** for use with non-metallic sheathed cable. Where **grounded** metal boxes are not required **outlet** and **switch** boxes may be of fire-resistive moulded composition **insulating** material, with covers of the same material.
- (l) Boxes used for flush devices shall be not less than 3 in. deep except that, in narrow partitions, shallow boxes may be used wherever not more than one joint is to be made in a box.
- (m) The cable may be used in open-wiring work under the following conditions:—
- (1) If supported directly upon surfaces of woodwork, plaster, concrete, brick or other building finish.
 - (2) If it be adequately protected wherever it is less than 5 ft. above a floor. If run horizontally along a wall it shall be at least 6 in. above the floor.
- Note: See Rule 501 (h) to (q).*
- (n) In **concealed** wiring the cable may be *fished*, if it be impracticable to provide the supports specified in Clause (e).
- Note: See "Knob-and-tube Work"—Rule 503.*

Rule 511

Underfloor Raceways.

(See *Raceway and Armoured-cable Work—Rule 504.*)

- (a) **Underfloor raceways** shall be used only in normally dry locations in **buildings** of **fire-proof** construction. They shall be embedded in the concrete or concrete fill of the floor.

They shall not be used for **conductors**, the potential-difference between any two of which exceeds 300 volts, nor for any **conductor** larger than No. 8 **B. & S. Gauge**, nor for any **conductor** protected by an **over-current device** rated or set at more than 30 amperes.

Note: Underfloor raceways may be placed in the concrete fill between the rough and the finished floor when there is at least 1 in. of concrete placed above the raceway.

- (b) **Underfloor raceways** of open-bottom type shall not be used in floors of monolithic construction.
- (c) **Underfloor raceways** of open-bottom type shall not be used in shallow-floor concrete fills unless proper cover is maintained and either a pad of concrete not less than 1 in. thick, or **approved** fittings, protect the wire from contact with piping, structural steel or other metal. The **raceway** shall be laid on a smooth, clean, surface and, in deep concrete fills, it shall be brought to the proper level by setting it on a concrete pad of proper thickness and at least twice the width of the **raceway**.
- (d) **Underfloor raceways** shall be so laid that a straight line from the centre of one junction box to the centre of the next will coincide with the centre line of the **raceway**. **Raceways** shall be mechanically secured to prevent disturbance of this alignment during construction.
- (e) All joints along edges of **raceways** and between **raceways**, couplings, and junction-boxes, and between the junction-box cover-plates and cover-ring, shall be filled with an **approved** waterproof cement. **Raceways** shall be so arranged that there will be no low points or traps either at the fittings or in the **raceway** run. Crossings shall be avoided wherever possible.
- (f) If **raceways** be run at other than right angles, special fittings shall be provided if, in the judgment of the **Inspection Department**, these be necessary. Connection between **raceways** and distribution-centre or wall **outlets** shall be by means of **conduit** or **approved** fittings. Dead-ends of **raceways** shall terminate in junction-boxes or other **approved** fittings.

- (g) Inserts and outlets in **raceways** shall be made both mechanically and electrically secure. Inserts in fibre **raceways** shall be screwed into the fibre and shall not be set until the floor is laid unless they are made mechanically secure by separately grouting them in. All inserts and junction boxes shall be carefully levelled to the floor grade and sealed with water-tight plugs.
- (h) Care shall be exercised in setting inserts and when cutting through the **raceway** wall that chips and other dirt do not fall into the **raceway**. Special tools designed to eliminate this objection and to prevent the tools from entering the **raceway** and injuring **conductors** already there, shall be employed.
- (i) Metal **raceways** and metal fittings shall be suitably protected from corrosion.
- (j) Multiple-channel **underfloor raceways** may be employed and may carry the **conductors** of **different systems**, provided that each compartment contain only the **conductors** of one **system** and that the compartment allotted to each **system** maintain the same relative position throughout. The **systems** may include communication **systems**.
- (k) In open-bottom **raceways**, **approved** double-braid rubber-covered **conductors**, Type R, or **armoured-cable**, or non-metallic sheathed cable, shall be used. If it be impossible to install the cement pad required by Clause (c) above, at crossings with **conduit**, structural steel or other metal, **armoured-cable** shall be used for **branch-circuits**.
- (l) Not more than 10 **conductors** shall be placed in any one **raceway**, nor shall the combined cross-sectional area of all **conductors** (including **insulation**) exceed forty per cent (40%) of the interior cross-sectional area of the **raceway**: if only **armoured-cable** or non-metallic sheathed cable be contained this shall not apply. **Conductors** of interior wiring **systems** not electrically connected to each other within the **building** shall not be contained within the same **raceway**.
- (m) **Conductors** shall not be drawn in until the mechanical work on the **building** reaches a stage where damage to the **raceways**, fittings or **conductors** is not likely to occur.
- (n) Junction boxes shall not be used as **outlet** boxes, and the distance between adjacent boxes in the same run of **raceway** shall not exceed 60 ft.
- (o) Metal **underfloor raceways** shall have a thickness of not less than No. 14 U.S. Sheet-metal Gauge.

Rule 512**Basements, Bathrooms, etc.**

- (a) In basements, bathrooms, kitchens, etc., and in any **damp place, exposed** non-current-carrying parts of lighting fixtures, etc. shall be made of **insulating** material unless they be **out of reach** or be **grounded**.
In such places drop-lights shall not be used and **lamp-holders** shall be keyless and shall be controlled by wall **switches**, unless exposed non-current-carrying metal parts be **grounded**.
- (b) In the lighting of basements the lamp which lights the stairs shall be controlled by a **switch** located at the top of the stairs.
- (c) Plug **receptacles** shall not be installed in bathrooms.
- (d) In single-family dwellings one-plug receptacles of 1000-watt capacity must be installed in each kitchen. The installation of an electric range equipped with a convenience **outlet** will constitute compliance with this requirement.

Rule 513

**Open Wiring on Exteriors of Buildings
and between Buildings on the same Premises**
(See also "*Service Conductors and Conduit*",—
Rules 402 (f) and (g).)

- (a) **Conductors** shall have either rubber **insulation** and/or a weatherproof covering.
- (b) **Conductors** supported on, or in close proximity to, the exteriors of **buildings** shall be so installed and protected that they will not be a menace to workmen or to other persons, and will not, themselves, be exposed to mechanical injury. They shall not be less than 12 ft. from the ground except by **special permission**.

Note: For exceptions see "Service Conductors and Conduit"—Rule 402(b).

If **conductors** are to be so located that they would be exposed to mechanical injury from awnings, swinging signs, shutters or other movable objects, they shall be run in **rigid conduit** made **waterproof**.

- (c) **Conductors** on the exteriors of buildings exposed to the weather shall be supported by brackets, racks, **insulators**, or other approved means, spaced at intervals not exceeding 9 ft. Individual **conductors** shall be separated at least 6 in. from each other and at least 2 in. from adjacent surfaces.

If **approved** brackets etc., be not used, petticoat **insulators** shall be used, so located that they will hold individual **conductors** at least 12 in. apart, and at least 2 in. from adjacent surfaces. These **insulators** shall be spaced at intervals not exceeding 15 ft.; if **conductors** are liable to disturbance this interval shall be suitably decreased.

Note: Conductors not exposed to the weather may be supported on glass or porcelain knobs placed at intervals not exceeding 4½ ft. and holding the conductors at least 1 in. from adjacent surfaces.

- (d) **Multiple-conductor** cables shall be treated as for **service conductors**. (See Clause 402 (f).)
- (e) **Conductors** shall be so located or **guarded** that they cannot be reached by a person standing on the fire escape, flat roof or any portion of a **building** to which normal access is provided. They shall be at least 6 ft. clear of the highest point of a flat roof.
- (f) **Conductors** passing *over* **buildings** shall, if practicable, be supported on structures which are independent of the **buildings**, but if this be impracticable they shall be securely supported on suitable trestles, constructed, preferably, of steel.
- (g) **Conductors** may only be carried *over* **buildings** by **special permission** and work shall not be commenced till plans and specifications have been approved by the **Inspection Department**.

Rule 514

Installation of Boxes, Cabinets, Outlet and Terminal Fittings.

- (a) On any two wires of a **branch-circuit** to which any flexible **conductor** or fixture-wire of less current-carrying capacity than that of a No. 14 **B. & S. Gauge** copper wire is connected, or is liable to be connected, the number of **outlets** shall not exceed 12.

Where fixed multi-outlet assemblies are employed, each five feet or fraction thereof of each separate and continuous length shall be considered as one **outlet**; except in locations where a number of appliances are likely to be used simultaneously, when each one foot or fraction thereof shall be considered as an **outlet**.

In telephone and telegraph equipment rooms the number of lighting fixtures associated with and mounted on equipment frames and/or the number of **outlets** mounted on equipment frames per circuit, need not be limited, provided that each **branch-circuit** is equipped with a **circuit-breaker** of not more than 15-ampere rating.

- (b) The number of mogul **lampholders** connected to any two wires of a **branch-circuit** shall not exceed 8.
- (c) **Conductors** of not less than No. 14 **B. & S. Gauge** shall be provided on circuits to which mogul **lampholders** and fixtures using these devices are connected.

*Note: Taps from the circuit wires to any fixture equipped only with mogul **lampholders** need not be of larger current-carrying capacity than is required for the **conductors** in the fixture.*

- (d) At each **outlet**, **switch**, or junction point of **conduit**, **surface-raceway**, **armoured-cable**, or non-metallic sheathed cable, and at each **outlet** and **switch** point of **concealed** knob-and-tube work, an **approved** box or its equivalent shall be installed. The box shall be provided with a cover, unless a fixture canopy be installed. Shallow boxes and plates may be used only by **special permission**. At least 6 in. of free **conductor** shall be left at each **outlet** for the making of joints or the connection of fixtures except where **conductors** are intended to loop through **lampholders**, **receptacles**, and similar devices, without joints.
- (e) An **outlet** or terminal fitting may be used instead of the box required by Clause (d) of this Rule at ends of **conduit**, **armoured-cable**, **surface-raceway**, and non-metallic sheathed cable, from which **conductors** are run without splice, tap or joint within the fitting, to appliances or to knob-and-tube wiring. The fitting shall provide a separately-bushed hole for each **conductor**; it need not be **accessible** if in **concealed** knob-and-tube work. Such fittings shall not be used at **outlets** for fixtures. An **insulating** bushing may be used instead of a box at ends of **conduit** where **conductors** leave the **conduit** behind a **switch-board**, or where more than 8 **conductors** leave the **conduit** at control apparatus, or in similar locations, in which case the **conductors** shall be bunched, taped, and painted with **insulating** paint.

- (f) In new work, metal supports shall be used for boxes and fittings which are not secured to a stud, joist or similar fixed structural unit except that a wooden board at least $7/8$ in. in thickness may be used for support if rigidly secured to such structural units. Lath, of wood, metal, or composition, shall not be accepted as a structural unit.
- (g) Boxes, **cabinets** and fittings shall be securely fastened in place. Boxes and fittings of less than 100 cu. in. attached to firmly-secured, exposed **raceway** by threading or other connection approved for the purpose shall be considered to be satisfactorily fastened.
- (h) If combination gas and electric outlets be employed, **outlet** boxes shall be securely bonded to the gas pipes. A fixture-stud or other suitable means of support shall be provided at every fixture **outlet** at the time of its installation.

Note: See "Installation of Fixtures and Pendant Lamps"—Rule 2010 (f).

- (i) Junction-boxes shall be so installed that wiring contained in them will be accessible without removing any part of the **building** structure.
- (j) **Boxes, cabinets** and fittings, in walls or ceilings shall be so installed that the front edges will not be set in from the finished surface more than $1/4$ in. On wooden or other combustible walls or ceilings, the front edges shall be flush with the finished surface, or shall project therefrom. A plaster surface which is broken or incomplete shall be repaired, so that there will be no gaps or open spaces at the front edges. **Outlet** boxes newly installed as additions to existing work may be mounted directly upon existing plaster surfaces if securely fastened in place.

*Note: The requirements of the first three sentences do not apply to walls or ceilings composed of concrete, tile or other **incombustible** material.*

- (k) In **damp places**, boxes, **cabinets**, and fittings shall be so placed or constructed as to prevent moisture from entering and accumulating within the devices.
- (l) Either couplings or bushings shall be provided at openings in boxes, **cabinets**, and fittings, for clamping or otherwise securing to them **conduit, raceways, armoured-cable**, non-metallic sheathed cable or **flexible tubing**. These couplings and bushings may be either units in themselves or form part of boxes etc., but in any case they shall adequately close the openings, including those for **conductors** run as open-wiring.

In dry places if knob-and-tube work be used, **approved flexible tubing** may be employed as an **insulating** bushing if it extend from the last **insulating** support and be firmly secured in place.

- (m) Unused openings in boxes, **cabinets**, and fittings shall be effectively closed by metal plugs or plates affording protection substantially equivalent to that of the wall of the box, etc.
- (n) In making a surface extension from an existing **outlet** of **concealed** wiring a box, or extension-ring shall be mounted over the original box and electrically and mechanically secured to it. The extension shall then be connected to this box in the manner prescribed for the method of wiring employed in making the extension.
- (o) **Conductors** of **different systems** shall not occupy the same box, **cabinet**, or **auxiliary gutter** unless a barrier of sheet steel not less than No. 16 U.S. Sheet-metal Gauge or its equivalent of suitable **insulating material**, be used to divide this space in order to separate the **conductors** of **different systems**. Such barrier shall be rigidly fastened to the box or **cabinet** unless an **approved** device assuring positive separation of the **conductors** be used. **Special permission** to vary from the foregoing shall be obtained in the following cases.
 - (1) A double-throw **switch** as used in some **emergency lighting systems**.
 - (2) The supply and control **conductors** of remotely controlled devices unless **insulated** for the same voltage.
- (p) The number of **conductors** running through or terminating in an **outlet** or junction box, shall be limited according to the free space within the box and the sizes of the **conductors**, as indicated in Tables IV and V.

TABLE IV
SPACE FOR CONDUCTORS IN BOXES

Size of Conductor B. & S. Gauge No.	Free Space Within Box for Each Conductor Cubic Inches
14	2.0
12	2.25
10	2.5
8	3.0

Note: For the patterns of boxes in common use and if no fittings such as fixture studs or hickey's be located within the box the foregoing will generally accommodate the numbers of conductors given in the following Table.

TABLE V
NUMBER OF CONDUCTORS IN BOXES

Box Dimensions	Maximum No. of Conductors			
	B. & S. Gauge No.			
	14	12	10	8
$1\frac{1}{2} \times 3\frac{1}{4}$ (Octagonal	4	4	2	—
$1\frac{1}{2} \times 4$ or Round)	10	8	6	4
$1\frac{1}{2} \times 4$ Square	12	10	8	6
$1\frac{1}{2} \times 4\frac{11}{16}$ Square	16	12	10	8
$2\frac{1}{8} \times 4\frac{11}{16}$ Square	20	16	12	10

Note: The above limitations are not intended to be applied to terminal housings supplied with motors nor to types of boxes or fittings without knockouts and having hubs or recessed ports for terminal bushings and locknuts.

- (q) Lighting **branch-circuit panelboards** shall not contain the **conductors** of more than 40 circuits if one **over-current device** per circuit be used or more than 20 circuits if two **over-current devices** per circuit be used.

Cabinets and **cutout boxes** housing such panelboards shall not contain more than one **panelboard** unless they comply with one of the following conditions.

- (1) The **cabinet** is divided between **panelboards** by an unpierced barrier of **incombustible** material.
- (2) The **panelboards** are located side by side or in a horizontal row.

Rule 515

Auxiliary Gutters

- (a) **Auxiliary gutters**, used to supplement wiring spaces at meter centres, distribution centres, **switchboards**, and similar points of interior wiring **systems**, may enclose **conductors** and cables or bus-bars, but shall not be used to enclose **switches**, **over-current devices** or other appliances or apparatus. An **auxiliary gutter** shall not extend a greater distance than 20 ft. beyond the equipment which it supplements; an **approved wireway** or **busway** may be used instead.

- (b) **Auxiliary gutters** shall be supported throughout their entire lengths at intervals not exceeding 5 ft.
- (c) Splices or taps, made and **insulated** by approved methods, shall be permitted within gutters if they are **accessible** by means of removable covers or doors.
- (d) The sum of the cross-sectional areas of all **conductors** (including **insulation**) and including splices and taps, at any cross-section of a gutter, shall not exceed twenty per cent (20%) of the cross-sectional area of the gutter at that point, and no single compartment of a gutter shall contain more than 30 **conductors** at any cross-section.
- (e) Bus-bars shall be securely and rigidly supported so that the minimum clearance between bare current-carrying metal parts of opposite polarities mounted on the same surface shall not be less than 2 in.; if the parts be held free in air the clearance shall be not less than 1 in. A minimum spacing of 1 in. shall be secured between bare current-carrying metal parts and any other metal surface. Adequate provision shall be made for expansion and contraction of bus-bars.
- (f) Taps from bus-bars shall leave the gutter opposite their terminal connections and **conductors** shall not be brought into contact with **uninsulated** current-carrying parts of opposite polarity.
- (g) Bare copper busbars in **auxiliary gutters** shall not be permitted to carry, continuously, currents greater than 1,000 amperes per sq. in. of cross-section of the busbars.
- (h) Tap connections from cables or **buses** shall be permitted without over-current protection if the conditions outlined in Rule 803(a) exist.
- (i) Tap connections shall be suitably marked at the gutter to indicate the circuit or equipment connected.

Rule 516

Wireways and Busways

- (a) **Approved** types of **wireways** and **busways** and fittings shall be permitted if installed in exposed dry locations in industrial premises for circuits of not more than 750 volts. They shall not be placed either in **hazardous locations** or in hoistways nor where they will be subject to severe mechanical injury. **Busways** shall also be permitted as risers and **feeders** in office **buildings** of **fire-proof** construction.

- (b) Runs of **wireways** shall be continuous throughout their entire lengths and shall be installed as complete systems without **conductors**. **Conductors** shall not be laid in until all the mechanical work on the **building** reaches a stage where damage to **wireways**, **busways** or **conductors** is not likely to occur. **Wireways** and **busways** shall be permitted to extend transversely through dry walls or partitions if they pass through in unbroken lengths. **Wireways** and **busways** shall be securely supported at least at every 5 ft. and dead-ends shall be closed by **approved** fittings.
- (c) **Conductors** used in **wireways** shall, for **ordinary conditions**, be of the rubber-covered (R) Type. In normally dry locations the varnished-cloth **insulated** (VC) Type may also be used. **Conductors** shall not be exposed to temperatures exceeding those specified in Table I. On **feeders** or on **branch-circuits** either splices or taps, if made and **insulated** by approved methods, shall be permitted within **wireways** provided that—
- (1) Such splices or taps are accessible by means of hinged covers or at pull boxes.
 - (2) Such splices or taps on motor-circuits having **conductors** larger than No. 6 B. & S. Gauge are made by **special permission**.
- (d) **Wireways** shall not contain more than 30 **conductors**, unless **special permission** be obtained for the use of a larger number, or unless all **conductors** in excess of 30 be for signalling circuits or be control **conductors** between a motor and its starter and be used only for starting. In any case the following provisions shall be met:
- (1) No **conductor** larger than 500,000 C.M. shall be used.
 - (2) The sum of the cross-sectional areas of all contained **conductors** (including **insulation**) shall not exceed twenty per cent (20%) of the interior cross-sectional area of the **wireway**, except that in the case of control **conductors** between a motor and its starter the limitation may be raised to forty per cent (40%).
 - (3) The temperature to which rubber-covered **conductors** in a **wireway** are exposed shall not exceed 50 deg. C. (122 deg. F.).
- (e) **Rigid** or **flexible conduit**, **surface raceways** or **armoured-cable** shall be used in extensions from **wireways** or **busways**, and shall be connected to the **wireway** or **busway** in a manner that is approved for the material employed, as specified elsewhere in this Section.

- (f) **Conductors of different systems** shall not occupy the same **wireway** or **busway** unless separated from each other by barriers.
- (g) If alternating current be employed all **conductors** of a circuit shall be placed within the same **wireway** or **busway**.
- (h) **Wireways** and **busways** shall be so marked that the manufacturer's name, trademark, or other recognized symbol of identification can be determined after the installation is completed.
- (i) Plug-in connectors or other devices for tapping off **branch-circuits** from **busways** shall be of **approved** types containing the necessary **over-current devices** required for the **branch-circuits**.
- (j) If either expansion joints or telescoping sections be used in **wireways** and **busways** bonding jumpers shall be provided.

Rule 517

Bare Bus-bars and Risers

- (a) **Conductors** serving as main risers or as **feeders** in **buildings** of **fire-proof** construction, and having no **insulating** covering shall be permitted, provided that **special permission** has been secured for each such installation and that the following requirements are met—
 - (1) The potential either between any two **conductors** of the circuit, or between any **conductor** and **ground**, shall not be more than 750 volts.
 - (2) The **conductors** shall be placed in a chase, channel or shaft which shall be so located or **guarded** that the **conductors** are not **accessible** to other than **qualified persons**.
 - (3) The premises shall not constitute a **hazardous location**.
 - (4) If floors be pierced suitable cut-offs against vertical travel of fire shall be provided.
 - (5) The mechanical and electrical features of the installation, including **conductor** supports, shall evince appropriate engineering consideration of the various operating and maintenance conditions likely to occur.

Rule 518

Auto-transformers and Circuits derived therefrom

- (a) Transformers in which part of the turns are common to both primary and secondary a.c. circuits, ordinarily known

as auto-transformers, may be connected to an interior wiring system only under one of the following circumstances. This Clause shall not apply where the auto-transformer supplies a wiring system or circuits wholly for motor uses.

(1) If the **system** supplied contain an **identified grounded conductor** which is solidly connected to a similar **identified grounded conductor** of the **system** supplying the auto-transformer.

(2) If the auto-transformer be used for starting or controlling an induction motor.

Note: The transformer may be included in a starter case or installed as a separate unit.

(3) If the auto-transformer supply a circuit wholly within apparatus which also contains the auto-transformer.

(4) If the auto-transformer be used for fixed voltage adjustment on an existing power circuit having no **identified grounded conductor**.

Rule 519

Insulation Resistance

(a) All wiring shall be so installed that, when completed, the **system** will be free from short-circuits and **grounds**.

*Note: In order that a reasonable factor of safety may be provided the following Table of **insulation resistance** is suggested as a guide where the **insulation** is subjected to test.*

TABLE VI
MINIMUM INSULATION RESISTANCES FOR INSTALLATIONS

Installation	Insulation Resistance Ohms
For Circuits of No. 14 or No. 12 wire	1,000,000
For Circuits of No. 10 or larger*	
25 to 50 amperes, inclusive	250,000
51 to 100 " "	100,000
101 to 200 " "	50,000
201 to 400 " "	25,000
401 to 800 " "	12,000
Over 800 " "	5,000

* *Note: Use in conjunction with Table VII.*

- (b) The values of **insulation** resistance given in Table VI shall be determined with all **switchboards, panelboards, fuseholders, switches, and overcurrent devices** in place.
- (c) If **lampholders, receptacles**, fixtures, or appliances are also connected, the minimum **insulation** resistance permitted for **branch-circuits** supplying them shall be one half the values specified in Table VI.
- (d) If climatic conditions be such that the wiring or equipment is exposed to excessive humidity it may be necessary to modify the foregoing provisions.

SECTION 6—CONDUCTORS

Rule 601

Sizes of Conductors and Conduit

- (a) **Conductors** shall, except for flexible cord and **extra-low-potential** control-circuit wire and cable, have a current-carrying capacity of not less than that of No. 14 **B. & S. Gauge** copper wire.

Extra-low-potential control-circuit wire and cable shall have a current-carrying capacity not less than the following:

- (1) When used in communication systems: No. 18 **B. & S. Gauge**.
- (2) When used on control and signalling systems: No. 16 **B. & S. Gauge**.

Note: There are special exceptions to this requirement under "Elevators"—Rule 3102(h).

- (b) The following Table shall be used in selecting **conductors** of copper. For aluminium the current-carrying capacity shall be taken as eighty-four per cent (84%) of the values given in the Table.

TABLE VII
MAXIMUM ALLOWABLE CURRENT-CARRYING CAPACITIES
OF CONDUCTORS
98 Per Cent. Conductivity

B. & S. Gauge	Area in Circular Mills	A Rubber Insulation. Amperes	B Varnished Cambric In- sulation. Amperes	C Other Ap- proved Insula- tion or Bare. Amperes
18	1,624	3	—	6
16	2,583	6	—	10
14	4,107	15	18	20
12	6,530	20	25	30
10	10,380	25	30	35
8	16,510	35	40	50
6	26,250	50	60	70
5	33,100	55	65	80
4	41,740	70	85	90
3	52,630	80	95	100
2	66,370	90	110	125
1	83,690	100	120	150
0	105,500	125	150	200
00	133,100	150	180	225
000	167,800	175	210	275
0000	211,600	225	270	325
	250,000	250	300	350
	300,000	275	330	400
	350,000	300	360	450
	400,000	325	390	500
	500,000	400	480	600
	600,000	450	540	680
	700,000	500	600	760
	750,000	525	630	800
	800,000	550	660	840
	900,000	600	720	920
	1,000,000	650	780	1,000
	1,100,000	690	830	1,080
	1,200,000	730	880	1,150
	1,300,000	770	920	1,220
	1,400,000	810	970	1,290
	1,500,000	850	1,020	1,360
	1,600,000	890	1,070	1,430
	1,700,000	930	1,120	1,490
	1,800,000	970	1,160	1,550
	1,900,000	1,010	1,210	1,610
	2,000,000	1,050	1,260	1,670

Notes 1. The above current values are maxima for single-cable circuit runs.

2. The maximum allowable current-carrying capacities of flexible cords are as follows:

Rubber-covered Cord No. 18—5 amps.

“ “ No. 16—7 amps.

Heater Cord

Types AFS, AFSJ, HC, HPD and HSJ

No. 18—10 amps.

No. 16—15 amps.

TABLE VIII
CONDUCTOR SIZES FOR 2 PER CENT. DROP IN POTENTIAL ON 110 VOLTS

No. of Amps.	Approximate Distance in Feet to Centre of Distribution.																	REMARKS				
	Conductor Sizes in B. & S. Gauge. Calculated for 60 deg. F. (15.6 deg. C.)																					
	20	30	40	50	60	70	80	90	100	120	140	160	180	200	240	280	320		360	400	450	500
1.0																16					14	
1.5																14					12	
2.0																12					10	
3.0																10					8	
4.0																8					6	
5.0																6					5	
6.0																5					4	
7.0																4					3	
8.0																3					2	
9.0																2					1	
10.0																1					1/0	
12.0																1/0					2/0	
14.0																2/0					3/0	
16.0																3/0					4/0	
18.0																4/0						
20.0																						
25.0																						
30.0																						
35.0																						
40.0																						
45.0																						
50.0																						
60.0																						
70.0																						
80.0																						
90.0																						
100.0																						
125.0																						
150.0																						
175.0																						
200.0																						
250.0																						
300.0																						

Figures in bold-faced type are only applicable to conductors with other than rubber insulation.

For 220 volts multiply the distance in feet by two, for the same percentage drop.

- (c) One **conduit** shall not contain more **conductors** of a given size than are specified in Table IX for rubber-covered covered **conductors** and Table XII for lead-covered **conductors**.

*Note: See “**Rigid and Flexible Conduit Work**” and “**Theatre Installations**”.*

*Tables IX, XI and XII apply only to complete **conduit** systems and not to short sections of **conduit** used for the protection of portions of **open** wiring which would otherwise be **exposed** to mechanical injury.*

TABLE IX
NUMBER OF RUBBER COVERED CONDUCTORS OF ONE SIZE ONLY
IN CONDUIT

One to Nine Conductors Rubber-Covered—0-600 V.
 Rubber Insulation with Double Braid or Tape and Braid
 except in Sizes No. 14 to No. 8 B. & S. Gauge inclusive.

Size of Conductor	Number of Conductors in One Conduit								
	1	2	3	4	5	6	7	8	9
No. 18	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{3}{4}$
16	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{3}{4}$	$\frac{3}{4}$	$\frac{3}{4}$
14	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{3}{4}$	$\frac{3}{4}$			
12	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{3}{4}$	$\frac{3}{4}$				
10	$\frac{1}{2}$	$\frac{3}{4}$	$\frac{3}{4}$	$\frac{3}{4}$		1			
8	$\frac{1}{2}$	$\frac{3}{4}$			1	1	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$
6	$\frac{1}{2}$	1	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{1}{2}$	2	2	2
5	$\frac{3}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{2}$	2	2	2	2
4	$\frac{3}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{2}$	2	2	2	2	$2\frac{1}{2}$
3	$\frac{3}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{2}$	2	2	2	$2\frac{1}{2}$	$2\frac{1}{2}$
2	$\frac{3}{4}$	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{1}{2}$	2	2	$2\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{1}{2}$
1	$\frac{3}{4}$	$\frac{1}{2}$	$\frac{1}{2}$	2	2	$2\frac{1}{2}$	$2\frac{1}{2}$	3	3
0	1	$\frac{1}{2}$	2	2	$2\frac{1}{2}$	$2\frac{1}{2}$	3	3	3
00	1	2	2	$2\frac{1}{2}$	$2\frac{1}{2}$	3	3	3	$3\frac{1}{2}$
000	1	2	2	$2\frac{1}{2}$	3	3	3	$3\frac{1}{2}$	$3\frac{1}{2}$
0000	$\frac{1}{4}$	2	$2\frac{1}{2}$	$2\frac{1}{2}$	3	3	$3\frac{1}{2}$	$3\frac{1}{2}$	4
200,000 C.M.	$\frac{1}{4}$	2	$2\frac{1}{2}$	$2\frac{1}{2}$	3	3	$3\frac{1}{2}$	$3\frac{1}{2}$	4
225,000	$\frac{1}{4}$	$2\frac{1}{2}$	$2\frac{1}{2}$	3	3	$3\frac{1}{2}$			
250,000	$\frac{1}{4}$	$2\frac{1}{2}$	$2\frac{1}{2}$	3	3	$3\frac{1}{2}$			
300,000	$\frac{1}{4}$	$2\frac{1}{2}$	3	3	$3\frac{1}{2}$	$3\frac{1}{2}$			
350,000	$\frac{1}{4}$	$2\frac{1}{2}$	3	$3\frac{1}{2}$	$3\frac{1}{2}$	4			
400,000	$\frac{1}{4}$	3	3	$3\frac{1}{2}$	4	4			
450,000	$\frac{1}{2}$	3	3	$3\frac{1}{2}$	4	$4\frac{1}{2}$			
500,000	$\frac{1}{2}$	3	3	$3\frac{1}{2}$	4	$4\frac{1}{2}$			
550,000	$\frac{1}{2}$	3	$3\frac{1}{2}$	4	$4\frac{1}{2}$	5			
600,000	2	3	$3\frac{1}{2}$	4	$4\frac{1}{2}$	5			
650,000	2	$3\frac{1}{2}$	$3\frac{1}{2}$	4					
700,000	2	$3\frac{1}{2}$	$3\frac{1}{2}$	$4\frac{1}{2}$					
750,000	2	$3\frac{1}{2}$	$3\frac{1}{2}$	$4\frac{1}{2}$					
800,000	2	$3\frac{1}{2}$	4	$4\frac{1}{2}$					
850,000	2	$3\frac{1}{2}$	4	$4\frac{1}{2}$					
900,000	2	$3\frac{1}{2}$	4	$4\frac{1}{2}$					
950,000	2	4	4	5					
1,000,000	2	4	4	5					
1,100,000	$2\frac{1}{2}$	4	$4\frac{1}{2}$	6					
1,200,000	$2\frac{1}{2}$	$4\frac{1}{2}$	$4\frac{1}{2}$	6					
1,250,000	$2\frac{1}{2}$	$4\frac{1}{2}$	$4\frac{1}{2}$	6					
1,300,000	$2\frac{1}{2}$	$4\frac{1}{2}$	5	6					
1,400,000	$2\frac{1}{2}$	$4\frac{1}{2}$	5	6					
1,500,000	$2\frac{1}{2}$	$4\frac{1}{2}$	5	6					
1,600,000	$2\frac{1}{2}$	5	5	6					
1,700,000	3	5	5	6					
1,750,000	3	5	5	6					
1,800,000	3	5	6	6					
1,900,000	3	5	6						
2,000,000	3	5	6						

Notes: (1). *Where a run of **conduit** does not exceed 50 ft. in length and does not contain more than the equivalent of two quarter-bends from end to end: three No. 6 stranded conductors may be installed in 1-in. conduit. For services only, two No. 6, Type R, and one No. 6, bare, conductors or two No. 4 Type R and one No. 4, bare, conductors may be installed in 1-inch conduit; and two No. 2, Type R, and one No. 2, bare, conductors in $\frac{1}{4}$ -inch conduit. A smaller bare conductor may be used in each of the above combinations if of suitable current-carrying capacity. See Table VII.

(2) *More than 9 conductors may be permitted in a single conduit for conductors between motors and controllers, stage pockets and border circuits, sign flashers, elevator control conductors and signal circuits but the maximum number of conductors shall not exceed those specified in Table X:*

TABLE X
NUMBER OF CONDUCTORS (MORE THAN NINE) IN CONDUIT

Size of Conductor	Maximum Number of Conductors in Conduit						
	$\frac{3}{4}$ in.	1 in.	$1\frac{1}{4}$ in.	$1\frac{1}{2}$ in.	2 in.	$2\frac{1}{2}$ in.	3 in.
18	13	22	38	53	87	124	191
16	11	19	33	45	74	106	163
14		11	19	26	43	61	95
12			15	21	34	50	77
10			12	16	27	38	60
8				13	22	31	49
6						14	22

TABLE XI

CROSS-SECTIONAL AREAS OF CONDUIT AND OF RUBBER-COVERED CONDUCTORS

Nos. 14 to 8—Solid. No. 6 and over—Stranded.

Conductor		Conduit		
Size B. & S. Gauge or Circ. Mils	Approx. Area over Braid Sq. In.	Trade Size Inches	Internal Dia- meter Inches	Area Sq. In.
14	0.031	$\frac{1}{2}$	0.622	0.30
12	0.038	$\frac{3}{4}$	0.824	0.53
10	0.045	1	1.049	0.86
8	0.071	$1\frac{1}{4}$	1.380	1.50
6	0.13	$1\frac{1}{2}$	1.610	2.04
4	0.16	2	2.067	3.36
2	0.21	$2\frac{1}{2}$	2.469	4.79
1	0.27	3	3.068	7.38
0	0.31	$3\frac{1}{2}$	3.548	9.90
00	0.35	4	4.026	12.72
000	0.41	$4\frac{1}{2}$	4.506	15.95
0000	0.48	5	5.047	20.00
250,000	0.58	6	6.065	28.89
300,000	0.67			
350,000	0.75			
400,000	0.83			
450,000	0.91			
500,000	0.99			
550,000	1.08			
600,000	1.16			
650,000	1.23			
700,000	1.30			
750,000	1.38			
800,000	1.45			
850,000	1.52			
900,000	1.60			
950,000	1.68			
1,000,000	1.75			
1,250,000	2.22			
1,500,000	2.52			
1,750,000	2.85			
2,000,000	3.14			

TABLE XII
NUMBER OF LEAD-COVERED CONDUCTORS IN CONDUIT
 Lead-covered Wires and Cables 0-600 Volts

Size of Conductor	Size of Conduit to Contain Not More than 4 Cables											
	Single Conductor Cable				2-Conductor Cable				3-Conductor Cable			
	Cables in One Conduit				Cables in One Conduit				Cables in One Conduit			
	1	2	3	4	1	2	3	4	1	2	3	4
14	$1\frac{1}{2}$	$\frac{3}{4}$	$\frac{3}{4}$	1	$1\frac{1}{2}$	1	1	$1\frac{1}{4}$	$\frac{3}{4}$	$1\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{1}{2}$
12	$1\frac{1}{2}$	$\frac{3}{4}$	$\frac{3}{4}$	1	$\frac{3}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2
10	$1\frac{1}{2}$	$\frac{3}{4}$	1	1	$\frac{3}{4}$	$1\frac{1}{4}$	$1\frac{1}{4}$	$1\frac{1}{2}$	1	$1\frac{1}{2}$	2	2
8	$1\frac{1}{2}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2	1	2	2	$2\frac{1}{2}$
6	$\frac{3}{4}$	$1\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{4}$	$1\frac{1}{2}$	2	$2\frac{1}{2}$	$1\frac{1}{4}$	$2\frac{1}{2}$	3	3
4	$\frac{3}{4}$	$1\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{4}$	2	$2\frac{1}{2}$	$2\frac{1}{2}$	$1\frac{1}{2}$	3	3	$3\frac{1}{2}$
3	$\frac{3}{4}$	$1\frac{1}{4}$	$1\frac{1}{2}$	2	$1\frac{1}{4}$	2	$2\frac{1}{2}$	3	$1\frac{1}{2}$	3	3	$3\frac{1}{2}$
2	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2	$1\frac{1}{4}$	2	$2\frac{1}{2}$	3	$1\frac{1}{2}$	3	$3\frac{1}{2}$	4
1	1	$1\frac{1}{2}$	2	2	$1\frac{1}{2}$	$2\frac{1}{2}$	3	$3\frac{1}{2}$	2	$3\frac{1}{2}$	4	$4\frac{1}{2}$
0	1	2	2	$2\frac{1}{2}$	2	$2\frac{1}{2}$	3	$3\frac{1}{2}$	2	4	$4\frac{1}{2}$	5
00	1	2	2	$2\frac{1}{2}$	2	3	$3\frac{1}{2}$	4	$2\frac{1}{2}$	4	$4\frac{1}{2}$	5
000	$1\frac{1}{4}$	2	$2\frac{1}{2}$	$2\frac{1}{2}$	2	3	$3\frac{1}{2}$	4	$2\frac{1}{2}$	$4\frac{1}{2}$	$4\frac{1}{2}$	6
0000	$1\frac{1}{4}$	$2\frac{1}{2}$	$2\frac{1}{2}$	3	$2\frac{1}{2}$	3	$3\frac{1}{2}$	$4\frac{1}{2}$	3	5	6	6
250,000	$1\frac{1}{4}$	$2\frac{1}{2}$	3	3	..	..	..	..	3	6	6	..
300,000	$1\frac{1}{2}$	3	3	$3\frac{1}{2}$	..	..	..	..	$3\frac{1}{2}$	6	6	..
350,000	$1\frac{1}{2}$	3	3	$3\frac{1}{2}$	..	..	..	..	$3\frac{1}{2}$	6	6	..
400,000	$1\frac{1}{2}$	3	3	$3\frac{1}{2}$	..	..	..	..	$3\frac{1}{2}$	6	6	..
450,000	$1\frac{1}{2}$	3	3	4	..	..	..	..	4	6	6	..
500,000	$1\frac{1}{2}$	3	$3\frac{1}{2}$	4	..	..	..	..	4	6	..	..
600,000	2	$3\frac{1}{2}$	4	$4\frac{1}{2}$								
700,000	2	4	4	5								
750,000	2	4	4	5								
800,000	2	4	$4\frac{1}{2}$	5								
900,000	$2\frac{1}{2}$	4	$4\frac{1}{2}$	5								
1,000,000	$2\frac{1}{2}$	$4\frac{1}{2}$	$4\frac{1}{2}$	6								
1,250,000	3	5	5	6								
1,500,000	3	5	6	6								
1,750,000	3	6	6	..								
2,000,000	$3\frac{1}{2}$	6	6	..								

Note 1: The above sizes apply to straight runs or with nominal offsets equivalent to not more than two quarter-bends.

Note 2: It is recommended that bends have a minimum radius of curvature at the inner edge of the bend of not less than 10 times the internal diameter of the conduit.

- (d) For groups or combinations of **conductors** not included in Tables IX and X, the sum of the cross-sectional areas of the **conductors** (including **insulation**) installed in conduit shall not be more than the percentage of the interior cross-sectional area of the **conduit** specified in Table XIII.

TABLE XIII

(PER CENT) AREA OF CONDUIT OCCUPIED BY CONDUCTORS

	Number of Conductors				
	1	2	3	4	Over 4
Sum of Cross-sectional areas of Conductors (not lead covered) maximum (per cent)	53	31	43	40	40

Rule 602

Flexible Cords

(See "Neutral Conductors" Rule 603 (d)).

- (a) Flexible cord shall have a current-carrying capacity not less than that of No. 18 **B. & S. Gauge** copper wire except as noted in footnote to Table XIV.
- (b) Flexible cord shall be protected by an **insulating** bushing, or in some other suitable manner, where it enters a **lamp-holder** or other device.
- (c) Flexible cord shall not be used for the suspension of any device weighing more than $2\frac{1}{2}$ lbs. Flexible cord shall be used only for pendants, fixtures, **portable** lamps or other **portable** devices.
- (d) If flexible cord be used in conjunction with pull-off connectors such devices shall be so arranged that there will be no **live** parts **exposed** when the two halves of the connector are separated.
- (e) Flexible cords for pendants and **portable** devices, and for elevator lighting and control, shall conform to Table XIV.
- (f) Flexible cord used in show windows or show cases shall, except for chain fixtures, be provided with **approved** metal armour. The use of **approved portable** cord to supply current to **portable** lamps and other devices for exhibition purposes shall be permitted, provided that the supply be taken only from permanent wall or floor **receptacles**.
- (g) Flexible cords shall be as listed in Table XIV:

TABLE XIV
FLEXIBLE CORDS

Use	Trade Name	Type Letter	Braid on Each Conductor	Filler	Jacket	Outer Covering	
						Kind	Number
Attached to a Device	In Dry Places	AT	Cotton	None	None	None	—
			None	None	None	Cotton or Rayon	1
	In Damp Places	CT	Cotton	None	None	Cotton or Rayon	1 or None
		ATJ ² CTJ ²	None	Optional	Special Rubber Jacket	—	—
Pendant	Not Subject to Hard Usage	AFC AFPO AFPD	Cotton or Rayon	None	None	None	—
			None	None	None	Cotton or Rayon	1
			Cotton or Rayon	None	None	None	—
			None	None	None	Cotton or Rayon	1
Pendant or Portable	In Damp Places	CFC CFPO CFPD	None	None	None	None	—
		C	Rayon	None	Special Rubber Jacket	—	—
		POSJ-64 ¹ POSJ-32	None	None	None	Cotton or Rayon	1
		PO-64 ¹ PO-32 PO	Cotton	None	None	None	—
Subject to Hard Usage	In Dry Places	C	Cotton	None	None	Cotton or Rayon	1
		PD	Cotton	None	None	None	—
		P-64 P-32 P	Cotton	Optional	Rubber	Cotton	1
		CA PA	Cotton	None	None	Metal Armour Cotton and Metal Armour	1 2

TABLE XIV—Continued

Pendant or Portable	Subject to Hard Usage	In Damp Places	Braided Heavy-duty Cord	K	Cotton Moisture- proofed	Jute, Cotton, Sisal, Hemp, Twisted Paper, Moisture- proofed	None	Cotton Moisture- proofed	2
Subject to Extra-hard Usage			Armoured Moisture-proofed Reinforced Cord	PAWP	Cotton	Optional	Rubber	Cotton Moisture- proofed Metal Armour	2
			Junior Hard- service Cord	SJ	None	Optional	Special Rubber Jacket	—	—
			Hard-service Cord	S					
			Rubber-jacketed Heat-resisting Cord	AFS AFSJ	None	None	Special Rubber Jacket	—	—
Portable Heaters		In Dry Places	Heater Cord	HC	Cotton or Rayon	None	None	None	—
				HPD	None	None	None	Cotton or Rayon	1
			Rubber-jacketed Heater Cord	HSJ	Cotton or None	Optional	Cotton and Special Rubber Jacket	—	—
Christmas Tree and similar Decorative Lighting Outfits		In Dry Places	Christmas- tree Cord	X	Cotton	None	None	All Cotton or Cotton and Rayon	1 or None
				CX	All Cotton or Cotton and Rayon	None	None	None	—
				CXW	Cotton Moisture- proofed	None	None	None	—
Elevator Lighting and Control		In Damp Places	Elevator Cable	E	Cotton	Optional	Rubber	Cotton Flame- retarding Moisture- proofed	1
								Cotton, Outer one Flame- retarding Moisture- proofed	3

(See foot notes on following page.)

NOTES TO TABLE XIV

1. Types PO-64 and POSJ-64 are for use only with clocks, portable lighting devices and radios, of the table or mantle type which are not liable to be moved frequently and where appearance is a consideration.
2. Types AT, CT, ATJ and CTJ are suitable for use in lengths not exceeding 8 ft. when attached directly, or by means of a special type of plug, to a portable appliance rated at 50 watts or less and where such an appliance requires a cord of extreme flexibility. Types AT and ATJ are for use only on heating appliances.
3. Type K is suitable for use on theatre stages.
4. Type S is suitable for use on theatre stages, in garages, and elsewhere where flexible cords having rubber insulation are applicable and permitted by this Code.
5. Type E may have an approved composite assembly of steel and copper strands in the make up of the conductors.

General

For Types AFPO, CFPO, PO-64, PO-32, PO, POSJ-64 and POSJ-32 the individual conductors are laid parallel. For Type X the individual conductors may be either twisted together or laid parallel. For all other types the individual conductors are twisted together.

Rubber-filled or varnished-cumbric tapes may be substituted for inner braids.

In the following tabulation the various types of cords are shown in the B. and S. Gauge sizes in which they are at present approved.

Types	B. and S. Gauge
AT, CT, ATJ, CTJ	— 27 only
X	— 20 only
PO-64, POSJ-64, P-64, PWP-64, CX, CXW	— 18 only
PO-32, POSJ-32, P-32, FWP-32, SJ, AFSJ	— 18 and 16 only
AF, AFPO, AFPD, CFC, CFPO, CFDP, AFS	— 18 to 10 inclusive
HC, HPD, HSJ	— 18 to 14 inclusive
S	— 18 to 10 inclusive
C, CA, PD, K, E, PA, PAWP	— 18 and larger
P, PO, PWP	— 14 and larger

Rule 603

Neutral Conductors

- (a) The **neutral conductor** shall have sufficient current-carrying capacity to carry the maximum unbalanced load. The maximum unbalanced load shall be the computed load as determined by Rule 604, less all loads tapped from the **ungrounded conductors** and not connected to the **neutral**; except that the load thus obtained shall be multiplied by one hundred and forty per cent (140%) for 5-wire two-phase **systems**. A demand factor of seventy per cent (70%) may be applied to that portion of the computed load current in excess of 200 amperes.

*Note: A common **neutral conductor** may be employed:*

(a) *For two or three sets of 3-wire **feeders**.*

(b) *For two sets of 4-wire or 5-wire **feeders**.*

- (b) The **neutral conductor** shall be run direct from the **service box** to all centres of distribution and all branch connections to this **conductor** shall be made at such centres.

- (c) Bare, **neutral conductors**, except as permitted for **services**, shall be mounted on **insulators**: e.g. when run in **busways**.

*Note: This does not apply to the **supply service** or wiring within transformer vaults or approved enclosures.*

- (d) The **neutral conductor**, if any, and that **conductor** only, and the **grounded conductor** on 2-wire circuits, shall, in **conductors** up to and including No. 4 **B. & S. Gauge**, if **insulated** be **identified**. Flexible cord, if it be permanently attached at the supply end, as for example, in the case of pendant lights, shall also have one **conductor identified**. The coverings of the other **conductor** or **conductors** shall be finished to show a continuous colouring contrasting with that of the **identified conductor**.

- (e) If one of the circuit **conductors** is to be **grounded**, the **ground** connection shall be made to the **identified conductor** referred to in Clause (d).

- (f) For **conductors** larger than No. 4 **B. & S. Gauge** and for those having other than rubber **insulation**, **identification** shall either be continuous, as for No. 4 and smaller sizes, or else each continuous length of **conductor** shall, at the time of installation, be suitably labelled, or otherwise clearly marked, at each end so that it can be readily **identified**.

(g) No **identified conductor** shall be used as a **conductor** for which **identification** is not required by these Rules, except as follows:

- (1) In **armoured-cable** and non-metallic sheathed cable work, the **identified conductor** may be rendered permanently **unidentifiable** by painting or other suitable means. This shall be done at every point where, (e.g.) at junction boxes, etc., the separate **conductors** have been rendered **accessible** and visible by the removal of the outer covering of the cable.
- (2) If **armoured-cable** or non-metallic sheathed cable be used without the **identified conductor** forming part of the circuit, the **identified conductor** shall be cut off short, or other suitable means shall be employed, to indicate clearly that the **identified conductor** does not form part of the circuit. This shall be done at every point where the separate **conductors** have been rendered **accessible** and visible by the removal of the outer covering of the cable.

Rule 604

Feeders and Switches

Determination of Minimum Allowable Sizes

(For **conductors** supplying motor circuits see "Conductor Sizes for Motor Circuits"—Rule 605)

Notes (1) The demand factors and wattage requirements referred to herein are the minimum percentages of the total connected load which **conductors** shall be capable of carrying in accordance with Rule 601 (b). These figures are believed to be suitable for ordinary conditions. In any particular case the **Inspection Department** may, at its discretion, require the application of figures larger than those required by this Rule. In any doubtful case the **Inspection Department** should always be consulted.

(2) This Rule specifies actual demand factors and wattage requirements, only for those installations, or portions of installations, consisting of **branch-circuits** protected by **over-current devices** rated, or set, at not more than 15 amperes; except that requirements are also specified herein for those circuits which supply non-portable domestic electro-thermal apparatus.

(3) The sizes of **conductors** as herein determined do not take voltage drop into consideration. If necessary, the size should be increased to the extent that the total drop along lead and return **conductors** (on a 3-wire circuit, the outers) will not exceed 2%, the current being that obtained after applying the appropriate demand factor.

(4) The use of demand factors of less than 100% has the effect of reducing the size of **conductors** that would be otherwise required by Rule 601(b). The size of **conductors** and **switches** thus computed shall be the minimum used, except that, if the next smaller standard size in common use has a current-carrying capacity not more than 5% less than this minimum, the **Inspection Department** may, at its discretion, permit the use of the smaller size. The demand factors and wattage requirements do not apply to **service conductors** in cases where they would reduce the size of such **conductors** below No. 10 **B. & S. Gauge**. (See "**Service Conductors and Conduit**"—Rule 402 (e)).

(5) For sizes of **conductors** for motor circuits see Rule 605. Demand factors employed for classes of circuits not covered by Rule 605, if less than 100%, are subject to the specific approval of the **Inspection Department** in each individual case (See Clause (h) below). Such circuits will usually be in large or special installations; Rule 207 (a) and (b) requires that plans and specifications be submitted to the **Inspection Department**—this will involve the checking of **conductor** sizes and the determination of demand factors and wattage requirements.

(6) In calculating the size of a **feeder** the demand factor for the **feeder** is applied to the sum of the individual connected loads on the **sub-feeders**. It is not correct to apply it to the sum of the loads determined for the **sub-feeders** after the application of their demand factors.

Example: Two **sub-feeders** each supply 20 **branch-circuits** protected by 15-ampere fuses. According to Clause (b) below, the demand factor for each **sub-feeder** is 70%, and according to Clause (a) each of the 20 circuits is to be considered as carrying 10 amperes. The calculated load which each **sub-feeder** will have to carry is therefore:

$$20 \times 10 \times 70 \div 100 = 140 \text{ amperes.}$$

Again, the demand factor for the **feeder**, according to Clause (b) below, is 60%. The calculated load which the **feeder** will have to carry is therefore:

$$40 \times 10 \times 60 \div 100 = 240 \text{ amperes.}$$

- (a) Each **branch-circuit** protected by **over-current devices** rated, or set, at not more than 15 amperes shall be considered as having a connected load of not less than 10 amperes. If it be known or be reasonably certain that the connected load on such a circuit will be more than 10 amperes, the higher figure shall be considered as the connected load.
- (b) Minimum loads, in amperes, which **conductors** are to be capable of carrying (exclusive of loads due to non-**portable** domestic electro-thermal apparatus—see Clause (f)) shall be determined by the use of the following demand factors:—

TABLE XV
MINIMUM DEMAND FACTORS FOR FEEDERS TO SUPPLY
BRANCH-CIRCUITS FOR LIGHTING AND PORTABLE
APPARATUS

For Circuits Protected by Over-current Devices Rated or Set at not more than 15 Amperes in Premises other than those Specified in Rule 604 (d).

Total No. of Branch Circuits	Minimum Demand Factor Per Cent.
1 to 4	100
5 to 10	85
11 to 30	70
31 to 50	60
Over 50	50

- (c) *Minimum* loads, in amperes, which **conductors** for circuits supplying electric ranges are to be capable of carrying, shall be determined by the use of the following demand factors:—

TABLE XVI
DEMAND FACTORS FOR FEEDERS TO SUPPLY ELECTRIC RANGES

No. of Ranges	Demand Factor Per Cent	No. of Ranges	Demand Factor Per Cent
1	85	52	19.0
2	65	53	18.5
3	56	54	18.5
4	50	55	18.5
5	46	56	18.5
6	43	57	18.5
7	40.5	58	18.0
8	38.5	59	18.0
9	36.5	60	18.0
10	35.5	61	18.0
11	34.0	62	18.0
12	33.0	63	17.5
13	32.0	64	17.5
14	31.0	65	17.5
15	30.5	66	17.5
16	29.5	67	17.5
17	29.0	68	17.0
18	28.5	69	17.0
19	28.0	70	17.0
20	27.0	71	17.0
21	26.5	72	17.0
22	26.0	73	16.5
23	26.0	74	16.5
24	25.5	75	16.5
25	25.0	76	16.5
26	24.5	77	16.5
27	24.5	78	16.5
28	24.0	79	16.0
29	23.5	80	16.0
30	23.5	81	16.0
31	23.0	82	16.0
32	23.0	83	16.0
33	22.5	84	16.0
34	22.5	85	16.0
35	22.0	86	15.5
36	22.0	87	15.5
37	21.5	88	15.5
38	21.5	89	15.5
39	21.0	90	15.5
40	21.0	91	15.5

Note: Table continued on next page

TABLE XVI—*Continued*

No. of Ranges	Demand Factor Per Cent	No. of Ranges	Demand Factor Per Cent
41	21.0	92	15.0
42	20.5	93	15.0
43	20.5	94	15.0
44	20.0	95	15.0
45	20.0	96	15.0
46	20.0	97	15.0
47	19.5	98	15.0
48	19.5	99	15.0
49	19.5	100	15.0
50	19.0		
51	19.0	Over 100	14.5

Notes:

(1) *The values in the Table above apply to one or more cooking and baking appliances but not to other appliances.*

(2) *The demand factor for one range may also be applied to the **conductors** of a range **branch-circuit**.*

(3) *For ranges connected to 3-wire circuits divide the nameplate current-rating by 2 unless this rating be based on 220 volts.*

(d) The lighting load shall be computed in accordance with Table XVII and the number of lighting **branch-circuits** protected by **over-current devices** rated, or set, at not more than 15 amperes, into which any particular installation or portion thereof shall be sub-divided, shall be governed by it.

(1) Multiply the watts per sq. ft. (Column B) for the **building** or occupancy being considered, by the total floor area involved.

(2) Then apply the demand-factors (Column C) for the respective wattages as specified in Column B, to the load determined by Clause (a).

(3) The floor area shall be determined by the outside dimensions of the **building** or occupancy, and the number of floors, not including cellars, unfinished attics, open porches, and other spaces in dwellings not used as living quarters.

The demand-factors given in the following Table are based on average load conditions. If at any time it be found that the **conductors** will be, or are, overloaded, they shall be increased to comply with the provisions of

Note: (1) under the title of Rule 604.

TABLE XVII
WATTS PER SQUARE FOOT AND DEMAND FACTORS
FOR VARIOUS TYPES OF BUILDINGS

A Type of Building	B Watts per sq. ft.	C Demand Factor Per Cent
Single-family dwelling.....	2.0	100
Multi-family dwellings (other than hotels) and apartment houses.	2.0	See Table XV
Hotel*.....	1.0	75
Store**.....	3.0	100
Office Building up to 10,000 sq. ft..... 10,000 sq. ft. and over.....	2.0	90
	2.0	70
Industrial Commercial (Loft) Building (†).....	1.0	100
Garage.....	0.5	100
Hospital (††).....	0.75	75
School.....	3.0	100
Storage Warehouse.....	0.25	65

* *Exclude area of ballroom; specific ballroom load served shall be included.*

** *For each linear foot measured horizontally along the base, add the following: counter-cases, 25 watts; wall or standing cases, 50 watts; show windows, 200 watts.*

† *This includes **buildings** of more than one floor, used for manufacturing or merchandising.*

†† *Exclude area of X-ray rooms and operating suites; specific loads to be served shall be included.*

Notes:

- (i) *This Clause applies only to lighting circuits with or without convenience outlets. Other circuits are to be dealt with under either Clause (c) or Clause (f).*
 - (ii) *In ball-rooms of hotels, in the operating rooms and X-ray departments of hospitals and in all locations where conditions are manifestly special, Clause (f) shall be observed.*
 - (iii) *Industrial premises are those used for commercial and light-manufacturing purposes.*
 - (iv) *For show-window lighting the size of **conductors** used should be determined on the assumption that not less than 200 watts will be required per lineal foot, measured along the base of the window.*
- (e) For more than four **branch-circuits** protected by **over-current devices** rated, or set, at not more than 15 amperes, the estimated current, in amperes, to be carried by their **feeder**, shall be the sum of the amperages of the connected loads of such circuits multiplied by the demand factor appropriate to the number of **branch-circuits** involved, in accordance with Table XV Clause (b) above. (See also Clause (a) above.)
 - (f) In cases in which **branch-circuits** other than those referred to in this Rule are involved and also wherever it is known, or is reasonably certain, that there will be little or no diversity, demand factors higher than those given in Clause (b) shall be used in computing the sizes of **conductors**. Such demand factors, if less than one hundred per cent (100%), shall be approved by the **Inspection Department**.
 - (g) If a **conductor** supply one or more circuits for electric ranges or other non-**portable** domestic electro-thermal apparatus, in addition to circuits of the type specified in Clause (e), its current-carrying capacity shall be the sum of the current values, obtained as required in this Rule, for the two types of circuits.
 - (h) In the case of circuits, installations and conditions other than those referred to above, a demand factor of one hundred per cent. (100%) shall be employed unless **special permission** for the use of a smaller demand factor has been obtained.

Rule 605

Conductor Sizes for Motor Circuits

- (a) **Branch-circuit conductors** supplying an individual motor shall have a current-carrying capacity as shown in Table XXI, except that motors used for short-time, intermittent, periodic, or varying, duty shall have a current-carrying capacity not less than the percentage of the motor name-plate current rating as shown in Table XVIII.

TABLE XVIII
FOR DETERMINING CONDUCTOR SIZES FOR MOTORS
FOR SHORT-TIME DUTY

Classification of Service	Percentage of Name-plate Current-ratings of Motors				
	5 Min. Rating	10 & 15 Min. Rating	30 & 60 Min. Rating	2 Hour Rating	Con- tinuous Rating
Operating valves, raising or lowering rolls.....	110	120	150	200	—
Varying duty.....	110	120	150	180	200
Hoists, rolls, ore and coal-handling machines.....	85	90	95	110	140
Freight and passenger elevators, shop cranes, tool heads, pumps, etc.....	85	85	90	100	140

- (b) For motors having larger full-load current ratings than those given in Table XXI, calculation of the size of **conductors** shall be made on the same basis as that used in the compilation of the Table.
- (c) **Conductors** involved in a motor primary circuit or between a motor secondary and the controller shall have a current-carrying capacity not less than 125 per cent of the full-load current in such circuit. The secondary **conductors** between the controller and the secondary resistor shall have a current-carrying capacity not less than that given in the following Table.

TABLE XIX
FOR DETERMINING CONDUCTOR SIZES
IN THE SECONDARY CIRCUITS OF MOTORS

Resistor Duty Classification	Current-carrying capacity of Wire in Per Cent of Full-load Secondary Current
Starting Duty.....	55
Intermittent Duty.....	85
Continuous Duty.....	110

- (d) **Conductors** supplying two or more motors shall have a current-carrying capacity of not less than 125 per cent of the name-plate current-rating of the largest motor in the group plus the sum of the name-plate current-ratings of the remainder of the motors in the group.

Example: Load consisting of a group of squirrel-cage full-voltage-start motors, one 25 h.p.; one 10 h.p.; one 7½ h.p.; and one 5 h.p., 220-volt, 3-phase. Total load = 47½ h.p. = 128 amps. Add 25 per cent of full-load current of 25 h.p. = 16 amps. Total 144 amps. Conductor size required—2/0 B. & S. Gauge.

SECTION 7

CONTROL EQUIPMENT FOR ELECTRIC CIRCUITS,
MACHINES, AND APPARATUS

Rule 701

General

- (a) Each **feeder, branch-circuit** (except lighting or appliance **branch-circuit**) or piece of electrical apparatus, except as otherwise provided for in this Section or in other Sections dealing with specific equipment, shall be provided with **approved** manually operable devices which safely disconnect all **ungrounded conductors** of the circuit simultaneously, at the point of supply. Such devices shall not be connected in any **grounded conductor** unless they simultaneously disconnect all **ungrounded conductors**. If used as **service equipment**, they shall not be connected in a **grounded conductor** in any case.

Rule 702

Control Apparatus

- (a) **Isolating switches**, unless so located or **guarded** as to render them **inaccessible** to **unauthorized** persons, shall be so plainly marked as to reduce to a minimum the probability of their being opened under load.
- (b) **Knife switches** which are rated at more than 600 amperes shall be used only as **isolating switches**. Currents above 600 amperes at any voltage shall be broken only by oil **switches, circuit-breakers**, or remotely controlled devices, **approved** for such interrupting duty.
- (c) **Knife switches**, or other control devices, unless so located or **guarded** as to render them **inaccessible** to **unauthorized persons**, shall be of the externally operable type.
- (d) Enclosed **knife switches**, other than **isolating switches**, used on d.c. circuits, or on a.c. circuits above 30 amperes, shall have quick-break mechanisms.
- (e) **Knife switches** shall be mounted with their bases in a vertical plane. Single-throw **knife switches** shall be so mounted that their blades move in a vertical plane and that gravity will not tend to close them. Double-throw **knife switches** may be so mounted that the throw will be either vertical or horizontal but, if the throw be vertical, a positive locking device or stop shall be provided, so as to ensure the blades remaining in the open position when so set, unless it is not intended that the **switch** be left in the open position.

- (f) Single-throw **knife switches, circuit-breakers,** or magnet **switches,** shall be so connected that the blades, or moving contacts, will be **dead** when the device is in the open position.
- (g) Control devices, with the exception of **isolating switches,** shall be so located as to be **readily accessible:** remotely controlled devices will be considered as being **readily accessible** if the means of controlling them be so located. **Isolating switches** may be so located as to require the use of a hook stick to operate them.
- (h) Control devices, unless they be so located or **guarded** as to render them **inaccessible** to **unauthorized** persons, and to prevent fire hazards, shall have all current carrying parts in either metal or **fire-resistive** enclosures.
- (i) Manually operable control devices shall indicate the “on” and “off” positions, unless the application of the devices be such as to make this requirement unnecessary.
- (j) Control devices used in combination with **overcurrent devices** or **overload devices** for the control of circuits or apparatus shall be so connected that the **overcurrent** or **overload devices** will be **dead** when the control device is in the open position.

Rule 703

Control of Circuits

- (a) Control devices controlling **feeders** and **branch-circuits** shall be grouped where practicable.
- (b) Control devices shall have a rating at least equal to the connected load of the circuit or circuits which they control. Snap **switches** used to control circuits supplying tungsten lamps, or mercury-vapour or luminous-discharge-tube lamps, and their transformers, shall have a rating at least twice that of such lamps or transformers unless the snap **switches** have a “T” rating, in which case the rating of the **switch** may be the same as that of such lamps or transformers.

Rule 704

Control of Apparatus

- (a) **Portable** appliances rated at not more than 1320 watts and provided with **approved** cord connectors, attachment-plug caps or other approved means by which they may be readily disconnected from the circuit, need not be equipped with additional control devices.

- b) **Switches** used to control the same **outlets** from more than one point shall be so wired and connected that the **grounded conductor** runs directly to the **outlets** controlled thereby.
- c) Each generator shall be provided with an **indicating switch** or **circuit-breaker** by means of which the generator, together with all protective devices and control apparatus, may be entirely disconnected from the circuits which it supplies.
- d) Each motor shall be provided with proper starting equipment rated in h.p., and, except as otherwise provided for in this Rule, each motor with its starting equipment shall be controlled by a **motor-circuit switch** or a **circuit-breaker** which will disconnect all **ungrounded conductors** of the circuit, leaving the motor and entire starting equipment **dead**. A **general-use switch** or an **isolating switch** may be used in place of a **motor-circuit switch** for motors of more than 50 H.P.
- e) The **motor circuit switch** called for in Clause (d) shall have a h.p. rating not less than that of the motor. If a **circuit-breaker**, an **isolating switch**, or a **general-use switch** be used, it shall have a rating not less than 115 per cent of the name-plate current-rating of the motor.
- f) A single-pole **motor-circuit switch** may be used to control a 2-wire **portable** motor of not over $1/4$ h.p. operating at a potential not exceeding 150 volts.
- g) A **switch** as required by Clause (d) shall be installed on the supply side of each auto-transformer starter, but may be omitted in the case of other types of starters, if the motor starters disconnect all **ungrounded conductors** of the circuit, provided that the motor be supplied by a separate motor **branch-circuit** which is controlled by a **motor-circuit switch**.
- h) In the following cases one **motor-circuit switch** may serve a group of motors.
- (1) If the motors drive several parts of a single machine or apparatus, such as metal and wood-working machines, etc., or cranes and hoists. (See Section 30).
 - (2) If a group of motors be under the protection of one set of **over-current devices**, as permitted in Rule 804 of this Code.

- (i) If motors be started by means of **switches** which have both a starting and a running position, such **switches** shall be so designed that they cannot remain in the starting position.
- (j) Each motor and its driven machinery shall be within sight of and not more than 30 ft. from the point from which the motor is controlled unless the controller, or **motor-circuit switch**, or **circuit-breaker**, is capable of being locked in the open position, or a manually operable **switch** which will prevent the starting of the motor is placed, with relation to the position of the motor, as outlined above. Such manually operable **switch** may be placed in the remote-control circuit of a remote-control type of controller.
- (k) Remote-control circuits of remotely controlled apparatus shall be so arranged that they may be disconnected from the source of supply at the controller. If the disconnecting of the apparatus from the supply circuit also disconnects the remote-control circuit from the supply circuit, this requirement will be considered as fulfilled.

SECTION 8

PROTECTIVE EQUIPMENT FOR ELECTRIC CIRCUITS,
MACHINES, AND APPARATUS

Rule 801

General

- (a) Electrical **conductors** and apparatus shall, in general, be provided with **approved** devices for the purpose of automatically opening the electrical circuit if the current reaches a value which will produce an excessive or dangerous temperature in the **conductor** or apparatus.

*Note: Such devices need not be provided for the protection of apparatus connected to lighting **branch-circuits**.*

- (b) Equipment used to control electric motors shall, where necessary, be provided with protective devices which will disconnect the motor from the supply circuit, in the event of failure of voltage in such circuit, as required in Rule 804.

Rule 802

Overcurrent Devices

- (a) **Over-current devices** shall be located in **readily accessible** places and shall be grouped where practicable.
- (b) **Over-current devices** shall be enclosed in **cutout boxes** or **cabinets**, unless they form a part of an approved assembly which affords equivalent protection, or unless mounted on **switchboards**, **panelboards**, or controllers located in rooms or enclosures free from easily ignitable material and dampness, and accessible only to **authorized persons**. Operating handles of **circuit-breakers** shall be made accessible without opening a door or cover giving access to **live parts**.
- (c) Enclosures for **over-current devices** shall be mounted in a vertical position unless, in individual instances, this is shown to be impracticable.
- (d) Individual **over-current devices** may be used at distribution centres if the number of lighting **branch-circuits** does not exceed four. At such centres, if the number of lighting **branch-circuits** exceed four, **over-current devices** protecting such circuits shall consist of an **approved** assembly in one **approved cabinet**. **Panelboards** and enclosed **branch-circuit** cutouts shall be of the **dead-front** type.

Note: For the purpose of this requirement a 3-wire circuit shall be classed as two circuits.

- (e) Plug fuses shall be used only on circuits not exceeding 150 volts, except that they may be used on any circuit having a **grounded neutral** if no **conductor** of the circuit exceed 150 volts to ground. Plug fuses shall be rated at not more than 30 amperes.

Note: Plug-fuse cutouts may be of the tamper-resisting type.

- (f) Plug-fuse cutout bases shall be of the so-called "covered" type.
- (g) Open-link fuses shall not be used.
- (h) Except as indicated below, every circuit protected by fuses shall be equipped with approved means whereby all **live** parts for mounting fuses can be readily and safely made **dead**; such approved means shall be capable of interrupting the circuit load of such circuit.

*Note: On **switchboards** such approved means may be omitted in the case of instrument and control circuits (0-250 volts) and of primary fuses of potential transformers.*

*In the case of plug fuses, this requirement will be considered to be complied with as these can be safely handled while **alive**. The intent of the word "readily" in the Clause is that the means provided shall be near at hand, and in the case of fuses installed in a **cabinet** the "means" shall be within the **cabinet**.*

*It is recognized that it may be desirable for the **Inspection Department** to permit exceptions in specific instances, but the necessity of making installations safe for the workman as well as for the consumer must be kept in mind.*

- (i) Short-circuiting or bridging of fuses, or the use of anything but an **approved** fuse and fuse holder of proper rating is strictly prohibited.

*Note: Inserting pieces of wire and metal in fuse-holders, and filling of plug and cartridge fuses with other than the proper elements which are specially **approved** for the purpose, are violations of this requirement.*

- (j) Fuses shall not be used as **over-current** devices when the required rating of such devices exceeds 600 amperes.
- (k) Except as provided for in Section 4 for **services**, a **circuit-breaker** shall have one pole in each **ungrounded conductor** and shall be so designed that when operated either manually or by the action of over-current, it will open the circuit in all **ungrounded conductors**.

*Note: **Over-current** trip devices forming part of a **circuit-breaker** may be of the thermal or magnetic type with either time-delay or instantaneous trip.*

- l) **Branch-circuit breakers** unless supplied as part of an **approved switchboard** and accessible only to **authorized persons**, shall be of such design that any alteration of either tripping current or time will be difficult.

Rule 803

Protection of Circuits

- a) Except as provided for below, every **ungrounded conductor** shall be protected by an **overcurrent device** at the point where it receives its supply of current and at any point where the size of **conductor** is decreased. Such protection may be omitted in the following cases:
- (1) If an **overcurrent device** in a larger **conductor** properly protect the smaller.
 - (2) If the smaller **conductor** have a current-carrying capacity not less than the sum of the allowable current-carrying capacities of the **conductors** of the one or more circuits or loads which it supplies; is not over five feet long; does not extend beyond the **switchboard, panelboard** or device which it supplies, and is enclosed in **conduit**, or in metal gutters when not a part of the **switchboard, panelboard** or other device.
 - (3) If circuits be for lighting and heating and if the smaller **conductors** have a current-carrying capacity at least $\frac{1}{3}$ that of the setting of the **circuit-breaker** protecting the larger **conductor** from which they are supplied, and provided that the tap is suitably protected from mechanical injury, is not more than 25 ft. long, and terminates in a single **circuit-breaker** which will limit the load on the tap to that allowed by Table VII. Beyond this point the **conductors** may supply any number of **circuit-breakers**.
 - (4) Fixture wire or flexible cord in sizes No. 16 or 18 **B. & S. Gauge**, and tinsel cord, shall be considered as protected by 15-ampere **overcurrent devices**.
 - (5) If the circuit be a motor **branch-circuit** with **conductors** having a current-carrying capacity at least $\frac{1}{3}$ that of the **conductors** from which they are supplied and not over 25 feet long, provided that the **conductors** from which they are supplied are protected by fuses or by a time-limit **circuit-breaker** rated or

set at not more than 400 per cent, or by an instantaneous **circuit-breaker** set at not more than 700 per cent, of the nameplate current-rating of the motor.

- (6) If the circuit be a motor **branch-circuit** supplying a group of motors, then the requirements of 803 (f) shall apply.
- (7) **Conductors** of control circuits of remotely controlled apparatus, less than 25 feet long, when suitably protected from mechanical injury. This omission may also be allowed in the case of longer **conductors** when the opening of the control circuit would create a hazard, as, for example, the control circuit of a fire-pump motor.
- (b) No **overcurrent** device shall be placed in any **neutral** or **grounded conductor** of a circuit unless it form a part of an **approved** device which, in the event of overcurrent in such **neutral** or **grounded conductor**, will disconnect all the **conductors** of the circuit. (See Rule 701(a)).
- (c) The rating or setting of **overcurrent** devices shall not exceed the allowable current-carrying capacity of the **conductors** which they protect as shown in Table VII, except as provided for in the case of motor **branch-circuits** (See Clauses 803(e) and (f)) and control circuits (See Clause 803(g)).

- d) **Circuit-breakers** shall be equipped with tripping elements as specified in Table XX.

TABLE XX

OVER-CURRENT TRIP-COILS FOR CIRCUIT-BREAKERS

System	Number and Location of Over-Current Devices
3-wire, 3-phase a.c. ungrounded	(a) 3 trip coils, one in each conductor if the circuit be served by transformers whose primaries are connected in Y, and with the neutral neither connected to the system nor grounded . (b) 2 trip coils, under all other conditions. Connect always in the same phases.
3-wire, 3-phase a.c. with grounded neutral .	3 trip coils, one in each conductor
4-wire, 3-phase a.c.	3 trip coils, one in each phase.
4-wire, 2-phase a.c. ungrounded	2 trip coils, one in each phase.
3-wire, 2-phase a.c.	2 trip coils, one in each outside conductor .
4-wire, 2-phase a.c. with grounded neutral	4 trip coils, one in each ungrounded conductor .
5-wire, 2-phase a.c.	4 trip coils, one in each ungrounded conductor .
3-wire, 1-phase a.c. or d.c.	2 trip coils, one in each outside conductor .
2-wire a.c. or d.c. ungrounded or with one conductor grounded .	1 trip coil, in each ungrounded conductor .
3-wire a.c. or d.c. with grounded neutral	2 trip coils, one in each ungrounded conductor .

*Note: This requirement will not prevent the use of one single-pole **circuit-breaker** in each **conductor** for the protection of an **ungrounded** 2-wire circuit.*

- (e) The rating or setting of **overcurrent devices** used on motor **branch-circuits** supplying a single motor shall not exceed maximum values shown in Table XXI.

Cutout bases shall accommodate the largest size of fuse permitted by Table XXI for the circuit.

- (f) The rating or setting of **overcurrent devices** used on motor **branch-circuits** supplying a group of motors shall not exceed the maximum values shown in Table XXI for the size of **conductor** for the largest motor used, plus the total full-load amperes of the remaining motors.

Example: Using the same group of motors as in the Example given in Rule 605 (d):

Maximum fusing allowed by Column 8, Table XXI for 64 amps. (Full load of 25 h.p., 3 phase, 220 volt). 250 amps.
 Total full-load amps. of remaining motors: 64 amps.

<i>Total</i>	<i>314 amps.</i>
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*As the nearest standard fuse is rated at 300 amps., fuses of that capacity would be required. If a time-element **circuit-breaker** is to be used, its capacity shall be such as will allow for a setting equal to the value required above for fuses.*

(See also Table XXVI)

FOR SELECTING SIZES OF CONDUCTORS, RATINGS OF FUSES FOR MOTOR CIRCUITS AND SETTINGS OF OVERLOAD DEVICES FOR MOTORS

Note: The following Table is based upon 125% of the full-load current-ratings of motors for conductor sizes and for the rating or setting of overload devices protecting motors while running.

Full-load current- rating of motor Amperes	Minimum Allowable Size of Copper conductor, B. & S. Gauge or Cir. mills.				Overload Protection For Running Protection of Motors		Overcurrent Protection Maximum Allowable Ratings of Fuses for Motor Circuits (For circuit-breaker setting see Table XXVI)				D.C. or Wound- rotor a.c. Amperes
	Rubber- covered	Varnished- cambric	Slow- burning	Max. Rating of fuses Amperes	Max. Setting of overload devices Amperes	Single Phase all types Amperes	Squirrel-Cage and Synchronous				
							Full- voltage Starting Amperes	Resistor and Reactor Starting Amperes	Auto- trans- former- Starting Amperes		
1	2	3	4	5	6	7	8	9	10	11	
1**	14	14	14	2*	1.25*	15	15	15	15	15	15
2**	14	14	14	3*	2.50*	15	15	15	15	15	15
3**	14	14	14	4*	3.75*	15	15	15	15	15	15
4**	14	14	14	6*	5.00*	15	15	15	15	15	15
5**	14	14	14	8*	6.25*	15	20	15	15	15	15
6**	14	14	14	8*	7.50*	20	25	20	15	15	15
7	14	14	14	10*	8.75*	25	30	25	20	20	15
8	14	14	14	10*	10.00*	25	30	25	20	20	15
9	14	14	14	12*	11.25*	30	35	30	25	25	15
10	14	14	14	15*	12.50*	30	40	30	25	25	15
11	14	14	14	15*	13.75*	35	45	35	30	30	20
12	14	14	14	15	15.00	40	50	40	30	30	20
13	12	14	14	20	16.25	40	50	40	35	35	20
14	12	14	14	20	17.50	45	50	45	35	35	25
15	12	12	14	20	18.75	45	60	45	40	40	25
16	12	12	14	20*	20.00	50	60	50	40	40	25
17	10	12	12	25*	21.25	60	70	60	45	45	30
18	10	12	12	25*	22.50	60	70	60	45	45	30
19	10	12	12	25*	23.75	60	80	60	50	50	30
20	10	12	12	25*	25.00	60	80	60	50	50	30

Note: Table continued on next page

TABLE XXI—Continued

Full-load current- rating of motor Amperes	Minimum Allowable Size of Copper conductor, B. & S. Gauge or Cir. mills.				Overload Protection For Running Protection of Motors		Overcurrent Protection Maximum Allowable Ratings of Fuses for Motor Circuits (For circuit-breaker setting see Table XXVI)				
	Rubber- covered	Varnished- cambric	Slow- burning	Max. Rating of fuses Amperes	Max. Setting of overload devices Amperes	Single Phase all types Amperes	Squirrel-Cage and Synchronous				D.C. or Wound rotor a.c. Amperes
							Full- voltage Starting Amperes	Resistor and Reactor Starting Amperes	Auto- trans- former- Starting Amperes		
1	2	3	4	5	6	7	8	9	10	11	
22	8	10	10	30	27.5	70	90	70	60	35	
24	8	10	10	30	30.0	80	100	80	60	40	
26	8	8	8	35	32.5	80	100	80	70	40	
28	8	8	8	35	35.0	90	100	90	70	45	
30	6	8	8	40	37.5	90	125	90	70	45	
32	6	8	8	40	40.0	100	125	100	70	50	
34	6	6	8	45	42.5	110	125	110	70	60	
36	6	6	8	45	45.0	110	150	110	80	60	
38	6	6	8	50	47.5	125	150	125	80	60	
40	6	6	8	50	50.0	125	150	125	80	60	
42	5	6	6	50	52.5	125	175	125	90	70	
44	5	6	6	60	55.0	125	175	125	90	70	
46	4	6	6	60	57.5	150	175	150	100	70	
48	4	6	6	60	60.0	150	200	150	100	80	
50	4	5	6	60	62.5	150	200	150	100	80	
52	4	5	6	70	65.0	175	200	175	110	80	
54	4	4	6	70	67.5	175	200	175	110	90	
56	4	4	6	70	70.0	175	225	175	120	90	
58	3	4	5	70	72.5	175	225	175	120	90	
60	3	4	5	80	75.0	200	250	200	120	90	
62	3	4	5	80	77.5	200	250	200	125	100	
64	3	4	5	80	80.0	200	250	200	150	100	
66	3	4	4	80	82.5	200	250	200	150	100	
68	2	4	4	90	85.0	225	250	225	150	110	
70	2	3	4	90	87.5	225	250	225	150	110	

Note: Table continued on next page

72	2	3	4	90	90.0	225	300	225	150	110
74	1	3	3	90	92.5	225	300	225	150	125
76	1	3	3	100	95.0	250	300	250	175	125
78	1	2	3	100	97.5	250	300	250	175	125
80	1	2	3	100	100.0	250	300	250	175	125
82	0	2	2	110	102.5	250	300	250	175	125
84	0	2	2	110	105.0	250	350	250	175	150
86	0	2	2	110	107.5	300	350	300	175	150
88	0	2	2	110	110.0	300	350	300	200	150
90	0	1	2	110	112.5	300	350	300	200	150
92	0	1	2	125	115.0	300	350	300	200	150
94	0	1	2	125	117.5	300	350	300	200	150
96	0	1	2	125	120.0	300	400	300	200	150
98	0	0	2	125	122.5	300	400	300	200	150
100	0	0	2	125	125.0	300	400	300	200	150
105	00	0	1	150	131.5	350	400	350	225	175
110	00	0	1	150	137.5	350	450	350	225	175
115	00	0	1	150	144.0	350	450	350	250	175
120	00	0	1	150	150.0	400	500	400	250	200
125	000	00	0	175	156.5	400	500	400	250	200
130	000	00	0	175	162.5	400	500	400	300	200
135	000	00	0	175	169.0	450	500	450	300	225
140	000	00	0	175	175.0	450	600	450	300	225
145	200,000	000	0	200	181.5	450	600	450	300	225
150	200,000	000	0	200	187.5	450	600	450	300	225
155	200,000	000	0	200	194	500	—	500	350	250
160	200,000	000	0	200	200	500	—	500	350	250
165	0000	000	00	225	206	500	—	500	350	250
170	0000	200,000	00	225	213	500	—	500	300	300
175	0000	200,000	00	225	219	600	—	600	350	300
180	0000	200,000	00	225	225	600	—	600	400	300
185	250,000	200,000	000	250	231	600	—	600	400	300
190	250,000	200,000	000	250	238	600	—	600	400	300
195	250,000	0000	000	250	244	600	—	600	400	300
200	250,000	0000	000	250	250	600	—	600	400	300
210	300,000	0000	000	250	263	—	—	—	450	350
220	300,000	250,000	000	300	275	—	—	—	450	350
230	350,000	250,000	200,000	300	288	—	—	—	500	350
240	350,000	250,000	200,000	300	300	—	—	—	500	400
250	400,000	300,000	0000	300	313	—	—	—	500	400

TABLE XXI—Continued

Full-load current- rating of motor Amperes	Minimum Allowable Size of Copper conductor, B. & S. Gauge or Cir. mills.				Overload Protection For Running Protection of Motors		Overcurrent Protection Maximum Allowable Ratings of Fuses for Motor Circuits (For circuit-breaker setting see Table XXVI)					D.C. or Wound rotor a.c. Amperes
	Rubber- covered	Varnished- cambric	Slow- burning	Max. Rating of fuses Amperes	Max. Setting of overload devices Amperes	Single Phase all types Amperes	Squirrel-Cage and Synchronous					
							Full- voltage Starting Amperes	Resistor and Reactor Starting Amperes	Auto- trans- former- Starting Amperes			
1	2	3	4	5	6	7	8	9	10	11		
260	400,000	300,000	0000	350	325	—	—	—	600	400		
270	500,000	350,000	250,000	350	338	—	—	—	600	450		
280	500,000	350,000	250,000	350	350	—	—	—	600	450		
290	500,000	350,000	300,000	350	363	—	—	—	600	450		
300	500,000	400,000	300,000	400	375	—	—	—	600	450		
320	500,000	500,000	300,000	400	400	—	—	—	—	500		
340	600,000	500,000	350,000	450	425	—	—	—	—	600		
360	600,000	500,000	350,000	450	450	—	—	—	—	600		
380	700,000	500,000	400,000	500	475	—	—	—	—	600		
400	700,000	600,000	400,000	500	500	—	—	—	—	600		
420	800,000	600,000	500,000	600	525	—	—	—	—	—		
440	800,000	700,000	500,000	600	550	—	—	—	—	—		
460	900,000	700,000	500,000	600	575	—	—	—	—	—		
480	900,000	700,000	500,000	600	600	—	—	—	—	—		
500	1,000,000	800,000	600,000	—	625	—	—	—	—	—		
520	1,000,000	800,000	600,000	—	650	—	—	—	—	—		
540	1,100,000	900,000	600,000	—	675	—	—	—	—	—		
560	1,200,000	900,000	700,000	—	700	—	—	—	—	—		
580	1,200,000	1,000,000	700,000	—	725	—	—	—	—	—		
600	1,300,000	1,000,000	700,000	—	750	—	—	—	—	—		
625	1,400,000	1,000,000	800,000	—	782	—	—	—	—	—		

TABLE XXII
THREE-PHASE A.C. MOTORS†
Amperes

HP	Induction-Type Squirrel-Cage and Wound Rotor					Synchronous Type ****Unity Power Factor			
	110V.	220V.	440V.	550V.	2200V.	220V.	440V.	550V.	2200V.
$\frac{1}{2}$ **	5	2.5	1.3	1	—	—	—	—	—
$\frac{3}{4}$ **	5.4	2.8	1.4	1.1	—	—	—	—	—
1*	6.6	3.3	1.7	1.3	—	—	—	—	—
$1\frac{1}{2}$	9.4	4.7	2.4	2.0	—	—	—	—	—
2	12	6	3	2.4	—	—	—	—	—
3	—	9	4.5	4	—	—	—	—	—
5	—	15	7.5	6	—	—	—	—	—
$7\frac{1}{2}$	—	22	11	9	—	—	—	—	—
10	—	27	14	11	—	—	—	—	—
15	—	38	19	15	—	—	—	—	—
20	—	52	26	21	—	—	—	—	—
25	—	64	32	26	7	54	27	22	5.4
30	—	77	39	31	8	65	33	26	6.5
40	—	101	51	40	10	86	43	35	8.6
50	—	125	63	50	13	108	54	44	10.8
60	—	149	75	60	15	128	64	51	13
75	—	180	90	72	19	161	81	65	16
100	—	246	123	98	25	211	106	85	21
125	—	310	155	124	32	264	132	106	26
150	—	360	180	144	36	—	158	127	32
200	—	480	240	195	49	—	210	168	42

NOTE: For full-load currents of 208 and 200-volt motors, increase the corresponding 220-volt motor full-load current by 6 and 10 per cent, respectively.

*, ****, † See end of Table XXV.

TABLE XXIII
TWO-PHASE A.C. MOTORS† (FOUR-WIRE)†
Amperes

HP	Induction-Type Squirrel-Cage and Wound Rotor					Synchronous Type ****Unity Power Factor			
	110V.	220V.	440V.	550V.	2200V.	220V.	440V.	550V.	2200V.
$\frac{1}{2}$ * $\frac{3}{4}$ * 1*	4.3 4.7 5.7	2.2 2.4 2.9	1.1 1.2 1.4	0.9 1.0 1.2	—	—	—	—	—
$1\frac{1}{2}$ 2* 3	7.7 10.4 —	4.0 5.0 8.0	2 3 4	1.6 2.0 3.0	—	—	—	—	—
5 $7\frac{1}{2}$ 10	— — —	13 19 24	7 9 12	6 7 10	—	—	—	—	—
15 20 25	— — —	33 45 55	16 23 28	13 19 22	—	—	—	—	—
30 40 50	— — —	67 88 108	34 44 54	27 35 43	7 9 11	56 75 94	29 37 47	23 31 38	5.7 7.5 9.4
60 75 100	— — —	129 156 212	65 78 106	52 62 85	13 16 22	111 140 182	56 70 93	44 57 74	11.3 14 18
125 150 200	— — —	268 311 415	134 155 208	108 124 166	27 31 43	228 — —	114 137 182	93 110 145	23 28 37

*, ***, †, ‡ See end of Table XXV.

TABLE XXIV
SINGLE-PHASE A.C. MOTORS†
Amperes

HP	110V	220V	440V
1/6*	3.34	1.67	—
1/4*	4.80	2.40	—
1/2*	7.00	3.50	—
3/4*	9.40	4.70	—
1*	11.00	5.50	—
1 1/2	15.2	7.6	—
2	20.0	10.0	—
3	28.0	14.0	—
5	46	23	—
7 1/2	68	34	17.0
10	86	43	21.5

NOTE: For full-load currents of 208- and 200-volt motors increase the corresponding 220-volt motor full-load current by 6% and 10% respectively.

*, † See end of Table XXV.

TABLE XXV
D. C. MOTORS†
Amperes

HP	115V	230V	550V
$\frac{1}{2}$ *	4.5	2.3	—
$\frac{3}{4}$ *	6.5	3.3	1.4
1*	8.4	4.2	1.7
$1\frac{1}{2}$	12.5	6.3	2.6
2	16.1	8.3	3.4
3	23.0	12.3	5.0
5	40	19.8	8.2
$7\frac{1}{2}$	58	28.7	12.0
10	75	38	16.0
15	112	56	23.0
20	140	74	30
25	185	92	38
30	220	110	45
40	294	146	61
50	364	180	75
60	436	215	90
75	540	268	111
100	—	357	146
125	—	443	184
150	—	—	220
200	—	—	295

NOTE: The following notes apply to Tables XXI to XXV as indicated.

†Values of current in common wire of 2-phase 3-wire system will be 1.41 times value given.

‡These values of full-load currents are average for all speeds and frequencies.

*For running protection of motors of 1 h.p. and less, see Rule 804(h).

**For the grouping of small motors under the protection of a single set of over-current devices, see Rule 804(i).

***High-reactance squirrel-cage motors are those designed to limit the starting-current by means of deep-slot secondaries or double-wound secondaries and are generally started on full voltage.

TABLE XXVI

**MAXIMUM RATING OR SETTING OF OVER-CURRENT DEVICES
FOR THE PROTECTION OF MOTOR BRANCH-CIRCUITS**

(Except as permitted in Table XXI where 15-ampere over-current protection for No. 14 B. & S. Gauge motor **branch-circuit conductors** exceeds the values specified in the following Table).

Type of Motor	Per Cent of Full-load Current		
	Fuse Rating	Circuit-breaker Setting	
		Instantaneous Type	Time-limit Type
Alternating Current			
Single-phase: All types.....	300	—	250
Squirrel-cage and Synchronous:			
Full-voltage Starting.....	400	700	250
Resistor, and Reactor Starting	300	—	250
Auto-Transformer Starting:			
Not more than 30 amps.....	250	—	200
More than 30 amps.....	200	—	200
Wound Rotor.....	150	—	150
Direct Current			
Not more than 50 h.p.....	150	250	150
More than 50 h.p.....	150	175	150

*Notes: (1) The ratings of fuses for the protection of **motor branch-circuits** as given in Table XXI, are based upon fuse ratings appearing in the Table above, which also specifies the maximum settings of **circuit-breakers** for the protection of **motor branch-circuits**.*

*(2) Synchronous motors of the low-torque low-speed type (usually 450 r.p.m. or lower) such as are used to drive reciprocating compressors, pumps, etc., and which start up unloaded, do not require a fuse rating or **circuit-breaker** setting in excess of 200% of full-load current.*

- (g) **Conductors** of control circuits of remotely controlled apparatus, when over 25 ft. long, shall, except as otherwise provided for in Rule 803 (a), (7), be protected by **over-current devices** rated or set at not more than three hundred per cent (300%) of their allowable current-carrying capacity and shall be installed in **conduit** or otherwise suitably protected from mechanical injury.

Rule 804

Protection of Apparatus

- (a) Constant-potential generators, whether d.c. or a.c., other than exciters for a.c. machines, shall be protected from excessive current by **overcurrent devices**; provided, however, that if the type of apparatus used and the nature of the **system** operated, make protective devices inadvisable or unnecessary, their omission may be permitted by the **Inspection Department**.

Note: If an a.c. generator and a transformer be intended to operate as a unit for stepping the voltage up or down, and both be located in the same building, the protective device may be connected to either the primary or the secondary of the transformer.

- (b) If a generator, not electrically driven, supply a 2-wire **grounded system**, the protective device shall be capable of disconnecting the generator from both **conductors** of the circuit.
- (c) Three-wire d.c. **systems** supplied by 2-wire generators operated in conjunction with balancer sets to obtain **neutrals**, shall be equipped with protective devices which will disconnect the 3-wire **system** in case of excessive unbalancing of voltages.
- (d) Three-wire d.c. generators, whether shunt or compound wound, shall be equipped with protective devices (one on each armature lead) so connected as to be actuated by the entire armature current. Such protective device shall consist of either a 2-pole **circuit-breaker** with two tripping elements, or of a 4-pole **circuit-breaker** connected in the main and equalizer leads and tripped by two tripping elements, one in each armature lead.
- (e) Motors, except as specifically provided for in Clauses (g), (h) and (i) shall be protected by individual **overcurrent devices** as shown in Table XXI.
- (f) For motors having larger full-load current ratings than those given in Table XXI, calculations for the rating or setting of **overcurrent devices** shall be made on the same basis as that used in the compilation of the Table.
- (g) No overload protection need be supplied for a motor of 1 h.p. or less if the motor **branch-circuit** be properly protected and the motor be visible from its starting device.

- (h) Two or more single-phase or d.c. motors each having a rating not greater than $\frac{1}{4}$ h.p. at 220 volts or less may be grouped under the protection of a single set of **over-current devices**, provided that the rating or setting of the **over-current device** does not exceed 15 amps. and the total load on the circuit does not exceed 1650 volt-amperes.
- (i) Two or more motors, each protected by an **overload device approved** for group fusing, may be connected to a **branch-circuit** protected by a single set of fuses or an instantaneous **circuit-breaker** rated in accordance with Rule 803 (f) provided that the rating of the fuse does not exceed the maximum capacity as indicated on the smallest capacity of **overload device** used.
- (j) Motors rated at more than 1 h.p. shall be provided with individual **overload devices**, except in cases where it is not practicable to obtain proper overload protection, when such **overload devices** may be omitted if the motors be protected by an individual **overcurrent** device as required by Table XXI.
- (k) Except as provided for in Clauses (h) and (i), **overload devices** which will not provide proper protection in the case of a short-circuit, shall have connected in series with them fuses or time-limit **circuit-breakers**, rated or set at not more than four hundred per cent (400%) of the motor full-load current, or instantaneous **circuit-breakers** set at not more than seven hundred per cent (700%) of the motor full-load current.
- (l) **Overcurrent devices** or **overload devices** providing running protection of motors shall be rated, or set, at values not greater than those shown in Table XXI.
- (m) If fuses be used for motor running protection there shall be one in each **ungrounded conductor**.
- (n) If **overcurrent devices** or **overload devices** other than fuses be used for the running protection of motors, the *minimum* allowable number and the location of tripping elements shall be as shown in Table XXVII.

TABLE XXVII
TRIP-COILS OR RELAYS FOR CIRCUIT-BREAKERS
PROTECTING MOTORS

Kind of Motor	Supply System	Number and Location of Over-current Units such as Trip-coils, Relays, or Thermal Cut-outs
1 phase a.c., or d.c.	2-wire, 1-phase a.c., or d.c., ungrounded.	1—in either conductor
	2-wire, 1-phase a.c., or d.c., one conductor grounded.	1—in ungrounded conductor
	3-wire, 1-phase a.c., or d.c., grounded neutral	1—in ungrounded conductor
2 phase a.c.	3-wire, 2-phase a.c., ungrounded.	2—one in each phase
	3-wire, 2-phase a.c., one conductor grounded	2—in ungrounded conductors
	4-wire, 2-phase a.c., grounded or ungrounded.	2—one per phase in ungrounded conductors
	5-wire, 2-phase a.c., grounded neutral or ungrounded.	2—one per phase in any ungrounded phase wire
3 phase a.c.	3-wire, 3-phase a.c., ungrounded.	2—in any two conductors
	3-wire, 3-phase a.c., one conductor grounded	2—in ungrounded conductors
	3-wire, 3-phase a.c., grounded neutral	2—in any two conductors
	4-wire, 3-phase a.c., grounded neutral or ungrounded.	2—in any two conductors except the neutral

- (o) Motor overload protection may be shunted out of circuit during the starting period provided that the device by which the protection is shunted or cut out cannot be left in the starting position; and the motor shall be considered as being protected against overcurrent during the starting period if fuses or time-delay-limit **circuit-breakers** rated or set at not more than four hundred per cent (400%), or instantaneous **circuit-breakers** set at not more than seven hundred per cent (700%) of the full-load current of the motor, be so located in the circuit as to be operative during the starting period of the motor.

If the overload release of a d.c. motor starter be inoperative during the process of starting the motor, a separate **over-current device** shall be provided.

- (p) If the automatic re-starting of a motor on return of voltage after stopping due to failure of voltage be liable to create a hazard or be otherwise undesirable, the motor control device shall provide **low-voltage protection**.

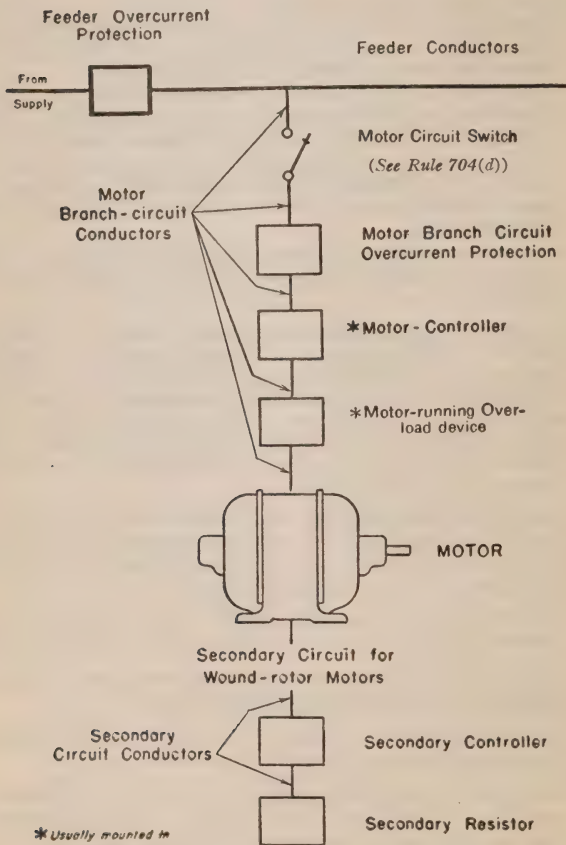
If it be necessary or desirable that a motor stop on failure of voltage and automatically re-start on return of voltage the motor control device shall provide **low-voltage release**.

*Note: When desirable, the protection outlined above may be supplied to a **feeder** or **branch-circuit** supplying a group of motors, in which case the individual motors need not be so **protected**.*

If it be evident that the automatic re-starting of a motor will not create a hazard, the protection referred to above may be omitted.

- (q) Medium-base **lampholders**, unless they form an integral part of a single lighting unit using mogul-base **lampholders**, and **receptacles** to which fixture wire or flexible cord of less than No. 14 **B. & S. Gauge** may be connected, shall not be connected to a circuit protected by **over-current devices** rated or set at more than 15-amperes for potentials up to 125 volts, or 10 amperes for potentials between 125 and 250 volts.
- (r) Mogul-base **lampholders** shall not be connected to a circuit protected by **overcurrent devices** rated or set at more than 40 amperes for potentials up to 125 volts, or 20 amperes for potentials between 125 and 250 volts.
- (s) Electro-thermal appliances shall be protected by **over-current devices** rated or set in accordance with Rule 2009.
- (t) Transformers shall be protected by **overcurrent devices** rated or set in accordance with Rule 2003.
- (u) Capacitors shall be protected by **overcurrent devices** rated or set in accordance with Rule 2004.
- (v) Except where **circuit-breakers** are used in the **branch circuits**, **panelboards** supplying lighting **branch-circuits** and which are supplied by **conductors** having overcurrent protection greater than 200 amperes shall be protected on the supply side by **overcurrent devices** having a rating not greater than that of the **panelboard**.

DIAGRAM OF MOTOR CONNECTIONS Feeder and Motor Branch-circuits



SECTION 9—GROUNDING

(For Grounding of Class 2 Communication Systems see Rule 6003—See also Rules 3003 (a), 3201 (d) Note; 3202 (n); 3203 (n); 3301 (i); 3401 (h) and 3501 (k).

Rule 901

WHAT TO GROUND

- (a) All **electrical equipment**, specified below under “Conductors”; “Equipment” and “Exposed Non-current-carrying Metal Parts” shall be **grounded**, except circuits operating at 50 volts or less if supplied from transformers energized at not more than **150 volts to ground** and neither exposed to probability of crossover from higher voltage circuits, nor installed outdoors.

Rule 902

Conductors

- (a) One **conductor** of all a.c. **systems**, and of **services** taken therefrom, if the maximum difference of potential between the **conductors** to be **grounded** and any other point on the circuit do not exceed 150 volts, as follows:—

TABLE XXVIII
CONDUCTORS TO BE GROUNDED
(See “Neutral Conductors”—Rule 603 (e))

System			Conductor or Point to be Grounded
Single-phase 2-wire below 150 volts			The identified conductor at the service box , otherwise either conductor .
Single-phase 2-wire between 150 and 300 volts			The neutral point of the transformer-secondary.
Single-phase 3-wire			The neutral conductor
2 and 3 phase	If only one phase be used if not more than 150 volts to ground .	If neutral be used in single phase.	The neutral conductor
		If no neutral be used in single phase	That conductor of the single phase which will establish on the system the lowest maximum voltage to ground .
	Otherwise If any conductor be not more than 150 volts to ground .		That conductor of the system which will establish on the system the lowest maximum voltage to ground .

*Note: It will conduce to the securing of effective **grounding** of **low-potential a.c. systems** if all **neutrals** be of ample cross-sectional area and be as far as practicable solidly interconnected throughout the **system**. This will place the **ground connections** in parallel and materially lower the resistance to **ground**. Such practice is strongly recommended.*

- (b) **Neutrals** of 3-wire d.c. systems.

Note: See Rule 906 (c).

- (c) **Negatives** of 2-wire d.c. **systems** at potentials not exceeding 300 volts, if exposed to leakage or induction from **high-potential conductors**.

*Note: In the case of 2-wire d.c. **systems** with potentials between wires exceeding 300 volts, **grounding** is not permitted unless a neutral point can be established such that the difference of potential between the neutral and any other point on the **system** does not exceed 300 volts, in which case such point may be **grounded**.*

- (d) One (either) **conductor** of the secondary circuits of current and potential transformers of less than 750 volts, unless isolated, run in **grounded conduit** or other suitable duct, or **identified** and **guarded** as required for **conductors** of the highest voltage to which they are exposed through transformer windings or otherwise.
- (e) No **Supply Authority** shall connect or re-connect to any a.c. supply any installation having one **conductor grounded** at the **service box** unless such supply has a corresponding **conductor** that is **grounded**, and, if the **supply service** be d.c., no **Supply Authority** shall connect it to a consumer's installation having a **conductor** which is **grounded**, or accidentally connected to the general mass of the earth. (See Rule 906 (c)).
- (f) The **Inspection Department** may, in any section of the area under its jurisdiction, require that **ground** connections at individual **services** be omitted if it be known to the **Inspection Department** to be impracticable to obtain, within such section, the resistance to **ground** required by this Code. No action, taken under this Clause, shall waive any requirement of this Code in relation to the **identification** of **conductors** or the polarization of fittings. (See Rule 910(e)).

Rule 903

Equipment

- (a) The **grounding-terminal** of lightning arresters.
- (b) The **grounding-conductor** for a d.c. **system** shall have a current-carrying capacity at least equal to that of the largest **feeder** (of the same **system**) leaving the station, but in no case shall it be less than No. 8 B. & S. Gauge.

Rule 904

Exposed Non-current-carrying Metal Parts

(a) Exposed non-current-carrying metal parts of the following:—

- (1) **Electrical equipment** operating at potentials exceeding 150 volts to ground.
- (2) **Electrical equipment** operating at any potential, in all locations where the risk of electrical shock is greater than it would be under **ordinary conditions**.
- (3) The **portable** appliances listed below:

*List of Portable Appliances, etc., for which a **grounding conductor** is required in the cord.*

Air Compressors
Air Conditioning Apparatus
(Industrial and Commercial)
Automobile Ignition Testers
Computing Scales
Coin and Slot Machines
Cream Separators
Dental Engines
Dishwashing Machines
Dough Mixers (Commercial)
Floor Surfacing and Cleaning
Machines
Food Choppers
Food Conveyors
Furnace Cleaners
Glass Washers
Grease Liquefiers
Hair Clippers (for horses)
Hair Steamers

Kitchen Ventilating Fans
(Industrial and Commercial)
Loading Machines
(Industrial)
Multigraph Whirlers and
Dryers
Permanent-wave Machines and
Hair Dryers
Popcorn Machines (For outside
use)
Rivet Heaters
Sand Slingers
Spray Guns (for melting and
spraying metals)
Sterilizers
Tools*
Welders
Wire Stitching Machine
X-ray Units

*"Tools" includes the following:

Buffers and Polishers
Concrete Vibrators
Cylinder Bore
Drills
Grinders
Hammers
Jointers
Magnetic Chucks
Mortisers
Pipe-cutting and Threading
Machines.

Routers
Sanders
Saws—Band and Circular
Screw-drivers
Shears
Tappers
Valve-seat Grinders
Valve-refacing Machines

Note: This list will be revised from time to time as necessitated by field experience or by new equipment coming on the market.

The **portable** appliances listed above shall have flexible supply cord containing an extra **conductor** not smaller than No. 16 **B. & S. Gauge**—either **uninsulated**, or, if **insulated**, having a green covering,—intended for use as a **grounding-conductor**. In cords of No. 12 **B. & S. Gauge** and larger, the **grounding-conductor** may be two **B. & S. Gauge** sizes smaller than the other **conductors**.

If **armoured** cord be used the **armour** shall be bonded to the **grounding-conductor** at each end of the run.

The **grounding** connection for any **portable** device or equipment shall be automatically established by the use of the type of plug specified in Rule 2011. For this purpose adapters for use with **lampholders** will not be accepted.

*Note: Special attention is drawn to the fact that this requirement includes the **grounding** of **exposed** non-current-carrying metal parts (if any) of **lampholders**, **switches**, **plugs** and **receptacles**, installed in basements, etc., and in all **damp places**, where danger from shock is likely to be incurred from handling such fittings should they become defective.*

- (4) **Approved** extension lamps, having handles of **insulating** material, and also metal guards for lamp bulbs so located as to be well **insulated** from **live** parts, need not have either the handle or the guard **grounded**.
- (5) Metal **outlet**, **switch**, and **receptacle** boxes on walls or ceilings covered with metal sheeting or metal lathing.
- (6) Non-**portable** electric ranges and other cooking or heating appliances—for all voltages.
- (7) Instruments, meters, and relays, operated from current or potential transformers. Instruments, meters, and relays, without current or potential transformers, and at potentials of more than 150 volts either between **conductors** on **ungrounded** circuits or to **ground** on **grounded** circuits, except that **grounding** may be omitted if potentials be between 150 and 750 volts provided that such instruments, meters, and relays be either isolated by elevation not exceeding 7 ft. or protected by suitable **insulating** barriers or **guards**, or so located as to be **inaccessible** to other than **authorized persons**. Instruments operating at 750 volts and over shall be isolated and **guarded** in addition to having non-current-carrying metal parts **grounded**.

*Note: It is recommended that in **industrial establishments** **portable** lamps and **portable** tools which are to be used in conductive locations be operated at 32 volts through the use of stepdown transformers having separate secondaries, thus obviating the need for **grounding** such **portable** equipment.*

- (b) **Service-boxes, metal raceways, wireways, busways and auxiliary gutters and metal sheathing and armouring of cable.**

*Note: This requirement need not be observed in the case of isolated sections of **metal raceways, metal-sheathed cable or armoured cable**, of less than 25 ft. in length if the potential between any two **conductors** does not exceed 300 volts, if they be either **out of reach** from, or are **guarded** from, other **grounded** objects, including the earth, and if they be **insulated** from **ground**. Similarly, metal cleats, clips, saddles, clamps, etc., used for fixing cables need not be **grounded**.*

- (c) Frames of motors and generators used to control sounding apparatus and keyboards of electrically-operated organs, if such frames be not effectually **insulated** both from **ground** and from each other.
- (d) Metal frames of elevator cars, not electrically-operated, if such frames be normally accessible and if any electrical **conductors** be attached to the car.
- (e) Shifting-cables of electrically-operated, or electrically-lighted, passenger and freight elevators, unless strain **insulators** be inserted in them.

Rule 905

HOW TO GROUND

- (a) **Grounding** of the circuit **conductors** and other **electrical equipment** listed under the heading "What to Ground," shall be carried out as specified below.

Note: See "Hazardous Locations"—Rules 3202 (n) and 3203 (n).

Rule 906

General

- (a) **Grounding** shall be so arranged that under normal operating conditions no injurious amount of current will flow in any **grounding-conductor**.
- (b) The path to **ground** provided for a circuit shall, in general, have ampere capacity sufficient to ensure the continuity and continued effectiveness of the path under conditions of excess current caused by accidental **grounding** of any normally **ungrounded conductor** of the circuit.
- (c) **Grounding** on 2-wire and 3-wire d.c. **systems** shall be made at supply stations only.

- (d) No **grounding conductor** used for **grounding** a Class 2 **communication system** (Section 60) shall be made use of for the **grounding** of any other type of electrical **system**, neither shall a **ground** purposely installed for the former **system** be made use of for the latter **system** unless it meet the requirements of a **grounding system** except as provided for in Rule 6003.
- (e) If there be an objectionable flow of current through a **grounding-conductor**, due to the use of multiple **grounds**, one or other of the following means of correcting this condition shall be adopted—
- (1) One or more of such **grounds** shall be abandoned, or,
 - (2) The location of the **grounds** shall be changed, or,
 - (3) The continuity of the common **grounding-conductor** connecting individual **grounding-conductors** shall be suitably interrupted, or
 - (4) Other suitable means shall be taken to limit the current.

Rule 907

Connections to Grounding-conductor

Note: Metal raceways and armouring, and grounding conductors enclosed in the same covering with the circuit conductors may be used for the grounding of exposed non-current-carrying metal parts.

Note: See "Raceway and Armoured Cable Work"—Rule 504.

- (a) Connections to **grounding-conductors** shall be on the supply side of the **service box** and shall be made before the installation is put into use. This will not prohibit the installation of a water-heater of the electrolytic type, connected to a **grounded** single-phase a.c. circuit, provided that—
- (1) A copper **grounding-conductor** conforming to the second column of Table XXIX, but in no case less than No. 12 B. & S. Gauge, be run connecting the frame of the heater to the **grounded conductor** of the circuit, at the **service box**.
 - (2) That the **grounded conductor** of the circuit be **grounded** at the **service box** to a **grounding system**.
- (b) The **conductor** or **conductors** used for **grounding** the exposed non-current-carrying metal parts of **electrical equipment** may be connected to the circuit **grounding-conductor**, if there be one*, under the following conditions:

- (1) If a **service** be supplied from a transformer or bank of transformers, the secondary **system** of which is connected to a **metallic water-piping system** for public supply, or, by **special permission**, to a **grounding system**.
- (2) If the potential between any two **conductors** of the **service** do not exceed 750 volts.

The point of attachment of the **grounding-conductor** for the exposed non-current-carrying metal parts of **service** equipment shall be on the **service conduit** or on the **service** cable sheath.

*Note: See "High Potential Installations"—Rule 5002 (h). *The phrase "if there be one" is intended to apply to existing systems. Systems to be built in the future are required by the Rules to have an identified conductor, hence the phrase will not apply to the latter.*

- (c) If transformers supply a common set of mains the **grounded** points shall be so interconnected that no portion of the secondary will be left without the protection afforded by **grounding** when any **over-current device** has opened the secondary circuit.
- (d) The point of attachment of the **grounding-conductor** to **electrical equipment** shall be **readily accessible**, if practicable, and shall be as near as practicable to the point where the **conductors** in the equipment receive their supply.
- (e) Connections to **grounding-conductors** from circuits, **conduit**, **cabinets** or equipment, etc., shall be made by means of suitable lugs, clamps, blocks, or other equivalent means.
- (f) In **damp places** bonding jumpers with **approved** fittings, or other suitable means, shall be used and the locknut bushing and double locknut type of contact shall not be depended upon for bonding metal boxes, **cabinets**, and the like, irrespective of the voltage of circuits contained therein.

Rule 908

Grounding-conductors

- (a) The size of copper **conductor**, iron pipe, **wireway** or **busway**, used as a **grounding-conductor** for the exposed non current-carrying metal parts of **electrical equipment** shall be not less than that given in the following Table:

TABLE XXIX
SIZES OF GROUNDING-CONDUCTORS
FOR EXPOSED NON-CURRENT-CARRYING METAL PARTS

Allowable current-carrying capacity of the largest conductor in either the service or the branch-circuit involved Amperes	Size of Copper Conductor B. & S. Gauge	Minimum Size of Water-Pipe to which a Grounding Conductor may be connected or which may be used in lieu of a grounding conductor. Trade Size Inch	Wireway or Busway not smaller than Inches
0—30	14	$\frac{1}{2}$	$2\frac{1}{2} \times 2\frac{1}{2}$
31—60	10	$\frac{1}{2}$	$2\frac{1}{2} \times 2\frac{1}{2}$
61—100	8	$\frac{1}{2}$	$2\frac{1}{2} \times 2\frac{1}{2}$
101—200	6	$\frac{1}{2}$	$2\frac{1}{2} \times 2\frac{1}{2}$
201—500	4	$\frac{3}{4}$	4×4
Over 500	2	1	4×4

Except that:

1. The **grounding-conductor** for the exposed non-current-carrying metal parts of **portable** equipment protected by **over-current devices** rated or set at not more than 15 amperes may be No. 18 B. & S. Gauge or larger.
2. The **grounding-conductor**, if any, for exposed non-current-carrying metal parts of instruments, meters and relays, and of current and potential transformers, may be No. 12 B. & S. Gauge or larger.
3. The **grounding-conductor** for **service conduit** shall be not less than No. 8 B. & S. Gauge.
4. The **grounding-conductor** for non-metallic sheathed cable as authorized by Rule 510(b) hereof shall conform to the following Table:

TABLE XXX
SIZES OF GROUNDING CONDUCTORS FOR
NON-METALLIC SHEATHED CABLE

Circuit Conductor B & S Gauge No.	Minimum Size of Grounding Conductor B. & S. Gauge No.
14	14
12	14
10	12
8	12
6	10
4	8

All **grounding-conductors** in cable larger than No. 12 shall be stranded.

- (b) The point of attachment of the **grounding-conductor** to **metal raceways, armoured-cable** and the like, shall be such that no part is **grounded** through a run of smaller size.
- (c) Exposed non-current-carrying metal parts of **electrical equipment** shall be bonded together if they be not already in good electrical connection. Gas-pipes within 2 in. of such parts shall be bonded thereto.
- (d) If the electrical path, between the **ground-electrode** and **electrical equipment** which is to be **grounded**, involve electrical contact between adjacent pieces of metal, all non-conductive substances such as protective enamel coating, rust, scale, paint, grease, etc., shall be completely removed from threads and other contact surfaces.
- (e) Except as provided below, or unless local conditions necessitate the use of other metal, the **grounding-conductor** shall be of copper and shall be continuous, and without joints or splices other than the joints permitted under "Connections to Grounding-conductor," Rule 907 (b). (See also Clause (g) below).
- (f) The **insulation** and installation of the **grounding conductor** shall conform to the general requirements of Rules governing the installation concerned.

Note: The insulation may be omitted if the grounding-conductor be installed in metal pipe and bonded to it at both ends.
- (g) All **grounding-conductors**, inclusive of the **grounding** clamps or plugs, shall be protected where exposed to mechanical injury. The protection for a lightning-arrester **grounding-conductor** shall be composed of non-magnetic material unless the **grounding-conductor** be electrically connected to both ends of the protective covering.

Note: If the intended location for a grounding-conductor be such that the conductor would require to be protected from mechanical injury, an iron pipe may be used as a grounding-conductor. (See Rule 501 (o) and Clause (a) above.)
- (h) Terminal and intermediate points of the **grounding-conductor** where electrical connection is made shall, wherever practicable, be in plain sight and **readily accessible**.
- (i) That portion of an interior water-piping system used as part of the **grounding-conductor** shall, in all cases, be as short as practicable, and wherever possible the copper

grounding-conductor shall be connected to the **metallic water-piping system** on the street side of meters, cocks and unions.

Interior water-piping systems or parts thereof, except sprinkler systems and the like, may be used as part of the **grounding-conductor** provided that the connection with the **metallic water-piping system** is kept continuous and permanent by bonding all parts which are liable to become physically disconnected—e.g., at meters and service unions—by means of a shunt consisting of two clamps and a **conductor** of the size herein specified for copper **grounding-conductors**.

- (j) There shall be but one **grounding-conductor** for any **system** within a **building**, connecting the **grounded conductor** of an interior wiring installation to that of an a.c. **system**.

*Note: This will not prevent there being more than one **grounding** connection to this **conductor**.*

- (k) The **grounding-conductor** for the **grounded conductor** of an a.c. **system** within a **building** shall have an ampere capacity not less than $1/5$ that of the **conductor** it is **grounding**, except that in no case shall the **grounding-conductor** be smaller than No. 8 B. & S. Gauge.

TABLE XXXI

SIZES OF GROUNDING-CONDUCTORS FOR SERVICE CONDUCTORS

Size of Grounded Service-conductor	Minimum Size of Service Grounding- conductor B. & S. G. No.	Minimum Size of Water Pipe to which Grounding - conduc- tor may be connected or which may be used in lieu of Grounding- conductor. Trade Size—Inch
Clr. Mils		
167,800 or smaller	8	$1\frac{1}{2}$
211,600	6	$1\frac{1}{2}$
250,000	4	$1\frac{1}{2}$
300,000	4	$1\frac{1}{2}$
350,000 to 500,000	2	$\frac{3}{4}$
600,000	2	1
700,000	1	1
800,000 to 1,000,000	00	1
1,100,000 to 1,400,000	000	1
1,500,000 to 1,900,000	0000	1

Note: 167,800 C.M. equals No. 000 B. & S. Gauge.

- (l) A **grounding-conductor** of No. 8 **B. & S. Gauge** may be used for **grounding** a **service conductor** supplying an installation in which knob-and-tube wiring is employed if the **service conductor** be not larger than No. 10. If the **service circuit-grounding-conductor** be used also as the **grounding-conductor** for exposed non-current-carrying metal parts, its size shall be increased to that required for the **grounding-conductor** for such parts if this be the larger.
- (m) The **grounding-conductor** for secondary circuits of current and potential transformers shall be not smaller than the **conductors** of the secondary circuit.
- (n) The **grounding-conductor** for lightning arresters shall have a current-carrying capacity not less than that of No. 6 **B. & S. Gauge** copper wire, and shall be run as nearly as possible in a straight line from the arrester to the **ground-electrode**.
- (o) No manually or automatically operated disconnecting device shall be placed in a **grounding-conductor** or its connections unless the opening of the device disconnects all circuit **conductors** as well as the **grounding-conductor**.
- (p) Lightning **conductors** shall not be used as **grounding-conductors** for circuits, or **conduit** or other non-current-carrying metal parts. **Grounding-conductors** shall be kept at least 6 ft. from lightning **conductors**.

Rule 909

Connection to Ground-electrode

- (a) The **grounding-conductor** shall be attached to the **ground-electrode** by means of **approved** clamps or plugs firmly attached to the **ground-electrode**, or by other suitable means.
- (b) **Ground** clamps are classified as indicated below, and shall be used only for the specific purposes for which they are intended and **approved**.

Classification of Ground Clamps

- (1) Those marked "Radio" and intended for use in the **grounding** of:
 - (i) Power-operated radio receiving sets.
 - (ii) Electrical communication systems.
 - (iii) **Portable** equipment protected by **overcurrent devices** rated or set at not more than 15 amperes.

- (2) Those known as "Heavy-duty" **ground** clamps and intended for any **grounding** purpose for which **grounding** clamps are suitable. For **grounding** the **neutrals** of interior wiring **systems** clamps shall be of the saddle-and-strap type.
- (c) The **grounding** connection to the **ground-electrode** shall be **readily accessible**.

Rule 910

Ground-electrodes

- (a) **Grounding** shall, wherever practicable, be made by direct connection to a **ground** consisting of a **metallic water-piping system** as provided for in Rule 908.
- If **grounding** to a **metallic water-piping system**, used for public supply, be not possible, connection shall be made either to a **metallic water-piping system** used for private supply, or to metallic well-casings, or piping connected thereto, if available.
- If a **ground** consisting of a **metallic water-piping system** be not available, a **grounded neutral** grid having **grounding system** characteristics shall be used if available.
- If none of the above methods be practicable, connection shall be made to one or more **grounds** which shall meet the requirements of a **grounding system**.
- (b) For the **grounding** of exposed non-current-carrying metal parts of **electrical equipment**, if none of the above methods be practicable, connection shall be made to **grounded** rails or **grounded conductors** of electric railway circuits, if available; but such connections shall not be used as a means of **grounding** for interior wiring circuits other than those supplied from the railway circuit itself.
- (c) Gas-pipes and gas mains shall not be used as **ground-electrodes** except at electrical stations for private supply. Connections shall be made on the street side of the meter.
- (d) Gas-piping may be used as a **ground electrode** for the non-current-carrying metal parts of **electrical equipment** installed on, and in conjunction with, gas appliances or gas-piping systems. Where gas-piping is so utilized it shall be bonded from the consumer's side of the gas meter to the water-piping system. If no water-piping system be available, a bonding jumper shall be connected around the gas meter and an **artificial ground** established. Gas-piping need not be **insulated** from otherwise well **grounded electrical equipment** used as an auxiliary to gas appliances, etc.

- (e) The **ground** resistance of a **grounding system** shall not exceed 6 ohms wherever practicable.
The resistance to **ground** obtained by a **ground-electrode** where practicable shall not exceed 25 ohms.
*Note: If individual connections to earth be supplemented by other **ground-electrodes** at the same point by being connected thereto to produce the required **ground** resistance of 25 ohms or less, the combination shall be covered by this Rule.*
- (f) **Ground-electrodes** shall be embedded, or shall extend, below permanent moisture level, and shall be placed, or driven, below basement floor wherever practicable. If no basement exists, care shall be taken that the **ground-electrode** is installed, or driven, outside the area of recently disturbed soil.
- (g) **Ground-electrodes** consisting of pipes of iron or steel shall be of not less than $\frac{3}{4}$ in. internal diameter, shall be galvanized inside and out, and shall be of only one piece when of not more than standard commercial length. **Ground-electrodes** consisting of rods shall be not less than $\frac{1}{2}$ in. in diameter.
Pipes and rods shall extend vertically into the earth 4 ft. below the level of permanent moisture or maximum frost penetration, except that in basements a minimum length of 4 ft. in the earth shall be permissible.
- (h) **Ground-electrodes**,—with the exception of **metallic water-piping systems** — **ground** connections, and **grounding-conductors**, used by one electric utility (including utilities supplying communication service) shall not be used by any other electric utility.

RECOMMENDATIONS

- (1) *Municipal and other authorities operating and controlling underground **metallic water-piping systems** are urged to permit the **grounding** of electric circuits and **exposed** non-current-carrying metal parts of **electrical equipment** by means of their systems where **grounding** is performed in accordance with these Rules, since such **grounding** offers the most efficient protection to life and property and is not injurious to the piping systems.*
- (2) *It is strongly recommended that all **grounds** be tested at the time of installation and periodically (say every 5 years) thereafter; also that all **ground** connections be inspected at the time of installation and periodically thereafter. Proper records of these tests and inspections should be kept.*

SECTION 20

INSTALLATION OF ELECTRICAL EQUIPMENT

Rule 2001

General

- (a) Adequate clear working space with secure footing shall be provided about all **electrical equipment** which requires adjustment or examination while danger of shock is present, either during operation or otherwise.
- (b) If any **electrical** machine or apparatus be rebuilt or rewound, with any change in its rating or characteristics, it shall be provided with a name-plate, in addition to the original name-plate, giving the name of the person or firm by whom such change was made, together with the new rating and characteristics. The **approval** requirements existing in the case of new electrical equipment shall apply as well in the case of re-built and re-wound equipment.

Rule 2002

Rotating Electrical Machinery

*Note: It is recommended that the starting current of motors be checked with the **Supply Authority**. (See Rule 605 and Sections 7 and 8).*

- (a) Rotating electrical machinery shall, where practicable, be installed in **locations** where **ordinary conditions** prevail.

*Note: Exception to this requirement may be made in the case of electrical machines especially designed or suitably protected for operation in locations where **ordinary conditions** do not prevail. (See "Sections 32, 33, 34 and 35).*

- (b) Generators shall not be installed in any **hazardous location** except as permitted in Sections 32 and 33.
- (c) If wood be depended upon to **insulate** frames of rotating electrical machinery from **ground** it shall be filled with moisture **repellant**.
- (d) Motors operating at a potential exceeding 750 **volts to ground** shall be **inaccessible** to **unauthorized persons**.

- (e) Each generator shall be provided with a name-plate showing the maker's name; revolutions per minute; normal volts and amperes corresponding to the rating; rating in kilowatts if d.c.; and, if a.c. rating in kilovolt-amperes; frequency in cycles per second, and number of phases.
- (f) Each motor shall be provided with a name-plate showing the maker's name; normal full-load speed in revolutions per minute; normal volts and amperes corresponding to the rating, including the rating of the secondary of a wound-rotor induction-type motor; rating in horsepower; and the period of time during which it can operate at rated full load. The time period given shall be 5, 10, 15, 30, 60 or 120 minutes, or continuous.

Motors of the so-called high-reactance type shall be so marked that the **inspector** will be able to identify the type without difficulty.

Rule 2003

Transformers

See also Section 32 and Rules 5002, 5004 and 5102.

- (a) In generating stations and sub-stations, transformers shall be so located that fire and smoke from burning **insulation** or oil will be unlikely to cause damage; if they are oil-cooled they should be installed in vaults unless they are located in a sub-station **building** used for no other purpose.
- (b) **High-potential** transformers in other than generating stations or sub-stations, whether filled with a liquid which will or will not burn, shall, when supplied by primary **services**, be located as near as practicable to the point of **service** entrance.

An air-space of at least 6 inches shall be provided between transformers and between them and adjacent surfaces.
- (c) Transformers adjacent to **buildings**, including their **conductors** and control and protective equipment, shall not be accessible to **unauthorized persons**; they shall not be located so as to interfere with firemen; they shall be isolated with respect to combustibility of surroundings, window exposure and nature of occupancy of adjacent **buildings**; drains for carrying away over-flowing liquid shall not come in proximity to combustible structures or materials; unless isolated by elevation they shall be surrounded by an enclosure, which if of metal, shall be **grounded**; suitable warning signs indicating the highest potential employed shall be conspicuously posted.

- (d) **High-potential** transformers containing a liquid that will burn where installed in, upon or adjacent to **buildings** (which are not generating and/or sub-stations), shall comply with the following requirements:
- (1) They shall when within a **building** be installed in a vault except as provided in sub-clauses 2 and 3 hereof.
 - (2) Transformers in electric furnace rooms of **fire-resistive** construction may be installed without a vault if provided with a concrete basin with curbs not less than 6 inches in height on the inside surface and of a dimension sufficient to retain all the oil used in the transformers. There shall be no other combustible material in the vicinity of such transformers.
 - (3) Transformers used with capacitors may, by **special permission**, be installed without a vault when provided with a concrete basin as described in the preceding paragraph of this rule and when the other requirements of Rule 5007 are complied with.
 - (4) Transformers mounted upon a roof of a **building** shall be installed in a vault.
 - (5) Transformers attached to the exterior of a **building**, or in immediate proximity thereto, shall be placed only against blank masonry or other non-combustible walls away from all openings so as not to expose combustible attachments such as eaves, cornices and porches. If attached to the **building** they shall be separated from it by substantial non-combustible supports, providing a separation of not less than 6 inches.
- (e) **Approved high-potential** transformers containing an **approved insulating** liquid which will not burn in air, when installed in, upon or adjacent to **buildings** (which are not generating stations or sub-stations), shall comply with the following requirements:
- (1) When installed within a building they shall:
 - i. Be surrounded by a suitable enclosure to prevent access by **unauthorized persons**.
 - ii. They shall be protected from mechanical injury.
 - iii. If installed in a confined space ventilation of the space shall be provided.
 - (2) When any transformer is rated in excess of 25 kva at 25 cycles, or $37\frac{1}{2}$ kva at 60 cycles, one of the following additional safeguards shall be provided:
 - i. Transformers shall be installed in a pan or basin of metal or concrete large enough to retain the liquid from the largest transformer.

- ii. Means of absorbing any gases generated by arcing inside the case of the transformer shall be provided.
 - iii. A pressure-relief vent shall be provided and if the space in which a transformer is located be poorly ventilated, the vent shall be connected to a chimney or flue which will discharge such gases into the outer air where they can do no harm.
- (3) When installed on the roof of a **building** they shall be located well away from doors or windows or, if located so that overflowing liquid might reach a window or door, they shall be mounted within a metal pan or concrete basin large enough to contain the liquid used.
 - (4) When mounted upon exterior walls or adjacent to buildings they shall comply with Rules 2003 (c) and 2003 (e) (5), except that no drainage system shall be required.
 - (5) Transformers exceeding 15,000 volts between terminals shall be installed in a vault.
- (f) **Low-potential** transformers rated at not more than 750 volts and 10 kva may be installed without a vault in a **building** or room of other than **fire-resisting** construction, if there is no combustible material in the vicinity of the transformer.
- Transformers rated at not more than 750 volts and not more than 25 kva in any one unit, or not more than 75 kva total rating, may be installed without a vault in a **building** or room of **fire-resisting** construction and containing no other combustible material in the vicinity of the transformer, if surrounded by concrete curbs not less than 6 inches high forming a basin of sufficient capacity to retain all the liquid used in the transformers.
- (g) **Low-potential** transformers of the dry-core type shall be so mounted that there will be an air space of at least $\frac{1}{4}$ inch between the transformer casing and adjacent surfaces. If any adjacent surface be of combustible material, the air space shall be increased to not less than 12 inches unless such surface be protected by **incombustible absorption-resisting insulating** material.

Note: Bell and/or signal transformers with primary potential not exceeding 250 volts are excluded from these requirements.

- (h) Each transformer or bank of transformers shall be protected against short-circuit conditions by **overcurrent devices** rated or set at not more than two hundred and fifty per cent (250%) of rated full load.
- (i) Potential instrument transformers shall be **protected** in the primary circuit by a **fuse** rated at not more than 3 amperes.

Note: It is recommended that an external resistor be placed in series with the primary winding of a potential instrument transformer of high voltage rating in order to limit a possible short circuit current to a value which can safely be interrupted by a fuse.

- (j) Each transformer shall be provided with a nameplate giving the maker's name, rating in kva, primary and secondary voltage ratings, frequency, and liquid capacity (if of the liquid-filled type) in gallons. If to be filled with an **approved** liquid that will not burn in air, the liquid shall be specified. (See Rule 203 (b).)

Rule 2004

Capacitors (Electrical Condensers)

Note: For hazardous locations see Section 32.

- (a) Capacitors shall be installed in accordance with relevant Clauses of Rule 2003 except where they are of the type made up of small units separately protected by **overcurrent devices**, and provided that if **flammable** oil be used each unit shall contain not more than 3 Imperial gallons.
- (b) Capacitors shall not be exposed to mechanical injury.
- (c) Capacitor banks other than those covered by Clause (e) shall be protected by a **circuit-breaker** or by a **switch** and fuse. The protective device shall be arranged to operate at a current corresponding to not more than one hundred and fifty per cent (150%) of the rated current of the capacitor in any **ungrounded conductor**.
- (d) Capacitors other than those directly connected to individual motors, (For exception see Clause (e)), without **switch** or **overcurrent device** interposed, shall be provided with means for draining the stored charge to 50 volts or less within one minute after the capacitor is disconnected from the source of supply. If the drain or discharge circuit be

not permanently connected to the terminals of the capacitor, or capacitor bank, automatic means shall be provided for connecting the capacitor to the discharge circuit on the removal of voltage from the line. Manual means of connecting the discharge circuit to the capacitor shall not be used.

- (e) Capacitors of 100 kva. or less, if associated with an individual motor of 100 h.p. or less, for power-factor correction, and if the kva. capacity of the capacitor does not exceed the horsepower capacity of the motor, may be connected at any point on the load side of the **motor-circuit switch** and **overcurrent device**, in which case:
 - (1) **Conductors** supplying the capacitor shall be of a size not less than those supplying the motor starter.
 - (2) No **overcurrent device** and no disconnecting **switch** need be connected in the capacitor circuit. The **overcurrent device** and **switch** in the motor circuit need not be of a rating greater than that required by the motor without the capacitor.
- (f) All **live** parts of capacitors shall be rendered **inaccessible** to **unauthorized** persons.

Rule 2005

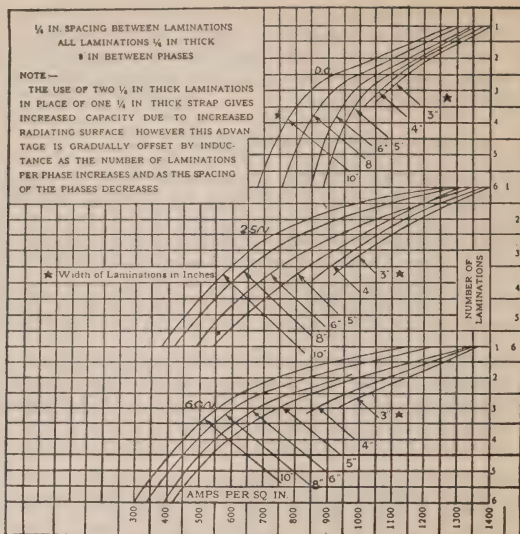
Switchboards

(For grounding of instrument cases on switchboards, see Rule 904(a) (7)).

- (a) Panels of **switchboards** shall be of **incombustible** material and shall be substantially supported on metal frame-work.
- (b) Only **switchboards** of the **dead-front** and enclosed types shall be accessible to **unauthorized persons**. In the case of **dead-front switchboards** live parts on the rear shall be **inaccessible** to **unauthorized persons**. When it is necessary to protect **exposed live parts** **switchboards** shall be **guarded** from falling objects. All other **switchboards** shall be **inaccessible** to **unauthorized persons**.
- (c) **Switchboards** shall not be built up to the ceiling, a space of 3 ft. being left, if possible, between the ceiling and the board. If this distance cannot be obtained, the ceiling shall be protected against fire from the **switchboard**.

Behind **switchboards** there shall be at least 3 ft. between equipment on the back of the **switchboard** and the wall. This space may be enclosed with a suitable netting or grating, but if so, provision shall be made for ready ingress and egress at each end.

- (d) Bus-bars if rigidly mounted may be bare.
- (e) **Conductors** of not less than No. 12 **B. & S. Gauge** copper wire shall be used for wiring to **ground** detectors, voltmeters, indicating integrating wattmeters.
Overcurrent devices shall protect such wiring to instruments mentioned above but where it is essential to maintain a complete circuit under all conditions of operation or where the opening of a circuit would create a dangerous condition such **overcurrent devices** shall be omitted.
- (f) For potentials between 150 **volts to ground** and 750 volts between **conductors**, suitable **insulating** floors, mats, or platforms, affording good footing, shall be provided and shall be so placed that operators cannot readily touch **live** parts unless standing on such floors, mats or platforms.
- (g) For potentials above 750 volts, all **live** parts of **switchboards** shall be either remote from access, or protected by suitable covers, even if **insulating** floors, mats, or platforms be provided.
- (h) Adequate illumination (for reading instruments and for operation, etc) shall be provided both in front of and behind **switchboards**.
- (i) **Switches** shall be labelled to indicate the destination or purpose of each circuit controlled thereby.
- (j) Bus-bars of smaller cross-sectional area than $\frac{3}{4}$ sq. in. shall be designed for a current density not exceeding 1,000 amperes per sq. in. Those of $\frac{3}{4}$ sq. in. and larger cross-sectional area may be designed under limitations imposed by the graphs shown on page 124.



BUS RATINGS

Note: Amperes per Sq. In., 30 deg. C. rise, based on 40 deg. C. Ambient Temperature.

The foregoing curves give the current-carrying capacity of the usual sizes of copper buses and are to be used for currents not exceeding 3000 amp. a.c. and 10,200 amp. d.c.

- (k) Temperature rises shall not exceed those specified below:
Above an ambient temperature of 40 deg. C. (104 deg. F.) while carrying either their rated or full-load current until temperatures, as indicated by either mercury all-glass thermometers or thermo-couples, become constant.
- (a) **Buses** (Open type)—35 deg. C. (63 deg. F.)
Connections and all other current-carrying parts:
Copper to copper—30 deg. C. (54 deg. F.).
- (b) **Buses** (Gum-filled type)—45 deg. C. (81 deg. F.).
Connections and all other current-carrying parts:
Tinned, sweated and gum-filled—40 deg. C. (72 deg. F.).

- (c) **Non-current-carrying metal parts**—70 deg. C. (126 deg. F.).

If silver contacts be used throughout, the following rises shall be permitted:

- (d) **Buses**—45 deg. C. (81 deg. F.)

Connections and all other current-carrying parts: 40 deg. C. (72 deg. F.).

- (l) If **non-enclosed air circuit-breakers** be mounted on the face of a **switchboard**, they shall be mounted in a single row at the top of the **switchboard**. The top of such **circuit-breaker**, mounted on the front of the **switchboard**, shall be not less than 5 ft. above the floor line.
- (m) **Insulated conductors** if closely grouped, as in the rear of **switchboards**, shall have an **approved flame-retarding, moisture-resisting** outer covering.
- (n) The space behind **switchboards** shall be kept clear of foreign material and shall not be used for storage purposes.

Rule 2006

Storage-batteries

Cells of the Open Type

(See also Rules 3203(r), 3301(h).)

- (a) Storage-batteries shall be placed in special rooms or enclosures used for no other purpose and **inaccessible** to other than **authorized persons**.
Note: If batteries be of the "enclosed" type, switchboards and control equipment may be installed in the same room.
- (b) Storage-battery rooms or enclosures shall be thoroughly ventilated.
Provision shall be made for sufficient diffusion and ventilation of the gases from the battery to prevent the accumulation of an explosive mixture in the battery room.
- (c) Each storage-battery cell—except small cells of **insulating** material set in sand-trays, on shelves, or otherwise separated from the floor—shall be mounted on **incombustible, absorption-resisting insulators** of such material as glass or thoroughly vitrified and glazed porcelain.
- (d) **Conductors** in battery rooms, if of such material, or so located, as to be liable to corrosion, shall be protected by suitable acid-proof coverings or coatings.

Rule 2007**Lightning-arresters**

- (a) A lightning-arrester, if used, shall be connected to each **ungrounded conductor** of every outside overhead line at every generating or transforming station.
- (b) Lightning-arresters located in **readily accessible** places shall be remote from combustible material and as near as practicable to the point where the **conductors** enter the station.
- (c) Lightning-arresters if installed inside a **building** shall be well isolated from other equipment.
- (d) Choke-coils and other attachments to lightning protection equipment shall have an **insulation** from **ground** and from other **conductors** at least equal to the **insulation** required at other points of the installation protected.
- (e) Sharp bends, coils and kinks in the **conductors** between the arresters and the outdoor lines shall be avoided as far as possible.
- (f) The connection between arrester and line **conductor** or **bus** and between arrester and **ground**, shall be of copper wire or cable, or some approved equivalent and shall not be smaller than No. 6 B. & S. Gauge.
- (g) Lightning arresters shall be **grounded**, according to the requirements of Section 9.

Rule 2008**Resistance Devices**

- (a) Rheostats, resistance boxes and similar equipment, if installed in dusty or linty places, or where exposed to flyings of combustible material shall be so constructed as to confine and quickly extinguish any arc or flame caused by the burning out of the resistive **conductor** and shall be equipped with dustproof face-plates.
*Note: For locations other than those above specified, these devices may be of any **approved** type.*
- (b) If **conductors** be grouped they shall not be supported by combustible material or located in dangerous proximity thereto. **Conductors** having **approved** flame-retarding outer covering may be grouped, provided that the maximum difference of potential between any two **conductors** in a group cannot exceed 75 volts.
- (c) Resistance devices shall be so installed that danger of communicating fire to adjacent combustible material will be reduced to a minimum.

- (d) If protective resistances be necessary in connection with automatic rheostats, incandescent lamps may be used, provided that they do not carry or control the main current or constitute the regulating resistance of the device.
- (e) Incandescent lamps may be used as resistances but shall be so arranged that they cannot have impressed upon them a voltage greater than that for which the device is intended. Such resistance devices shall be marked in a permanent manner to indicate the wattage and voltage of the lamps which are intended to be used therewith.
- (f) Incandescent lamps may, by **special permission**, be used as resistances in series with other devices, if mounted in porcelain **receptacles** upon **incombustible** supports and if so arranged that they cannot have impressed upon them a voltage greater than that for which the resistance is rated.

Rule 2009

Electro-thermal Appliances

(For "Grounding" see Rule 908)

- (a) Electro-thermal appliances may be grouped ~~on~~ **branch-circuits** used for no other purpose and protected by an **over-current device** rated or set at not more than 15 amperes, each appliance being rated at not more than 1,320 watts.
- (b) Each electro-thermal appliance, the maximum rating of which exceeds 15 amperes, shall be supplied from a **branch-circuit** used solely for one such appliance.
The appliance shall be controlled by an **indicating switch** which may be either on a circuit or on the appliance itself.
Note: An attachment plug and receptacle may serve instead of a switch if the rating of the appliance does not exceed 30 amperes.
- (c) If electro-thermal appliances such as smoothing-irons, glue-pots, soldering-irons, etc., or groups of such appliances, be used in manufacturing and **industrial establishments**, each device or group of devices shall be provided with an **indicating-switch** and a *red* pilot-light.
- (d) Non-**portable** electro-thermal appliances shall be so installed that danger of communicating fire to adjacent combustible material will be reduced to a minimum.

- (e) Electro-thermal appliances consisting of more than one individual heating element shall be designed with only one point of connection for supply.
- (f) If a **consumer's service** supply one electric range only, the **conductors** run from such **service** shall be not less in size than those specified under "**Service Conductors and Conduit.**"—Rule 402.

Rule 2010

Installation of Fixtures and Pendant Lamps

(See Rule 514)

- (a) **Conductors** of **different systems** shall not be contained in, or attached to, a fixture.
- (b) No joint or tap shall be located within an arm or stem of a fixture.
- (c) The **identified** supply **conductors** shall be connected to the **identified conductor** or **conductors** of each fixture.
Note: See also Rule 2011(i)

- (d) Fixtures attached to a **conduit** system or other **grounded** support shall be both mechanically and electrically connected thereto.
- (e) Canopies and **outlet** boxes shall, taken together, provide ample space for the proper making and protection of joints.
- (f) If electric fixtures be supported directly on walls or ceilings of metal or metal lath, such fixtures shall be effectually **insulated** therefrom, unless the non-current carrying metal parts of the fixtures be **grounded**.

Note: See Rule 904 (a) (5).

- (g) No externally-wired fixtures shall be located in the immediate vicinity of **flammable** material; nor shall any such fixture, of other than the chain type, be placed in a show window.
- (h) Flexible cord or fixture wire supplying fixtures which are lowered by winches or other means shall be adequately protected from mechanical injury.
- (i) Enclosures of recessed fixtures shall be spaced, except at points of support, at least $\frac{1}{2}$ in. from any adjacent combustible material.

- (j) Wiring to recessed fixtures shall be as follows:

Asbestos-covered **conductors**, not less than 4 ft. long, and either **armoured** or run in **metal raceways**, shall extend from the outside of the enclosure of the fixture to a junction box located not less than 1 ft. from the enclosure of the fixture. The temperature in this box shall not exceed 50 deg. C. (122 deg. F.), and the connection of the asbestos-covered **conductor** with the rubber-covered **branch-circuit conductors** shall be made in it.

*Note: Under the conditions outlined above the junction box need not be **accessible** if the connections therein are being made to a non-metallic sheathed cable or knob-and-tube wiring system.*

Rule 2011

Receptacles, Rosettes and Lampholders

(See Rules 513 and 602 (d))

*Note: It is strongly recommended that at least one convenience **receptacle** be installed on each wall of each living room, dining room and parlour of a private dwelling house, or an apartment suite; also that in all other rooms (except bathrooms) of such occupancies at least one such **receptacle** be installed.*

- (a) **Receptacles** (for so-called “convenience **outlets**” rated at not more than 15 amperes capacity) may be so constructed as to accommodate both parallel and tandem blade plugs. They shall not be of the screw-base type. Adapters for use with Edison-base **lampholders** shall be so constructed as to receive only parallel-blade caps.
- (b) **Receptacles** for so-called convenience **outlets** of the standard tandem or parallel type shall be rated at not more than 125 volts—15 amperes. **Receptacles** for such **outlets** rated at 250 volts shall be so constructed that standard tandem or parallel type caps cannot be inserted therein.
- (c) **Receptacles** and rosettes with **exposed** terminals shall not be used except where permitted in metal fittings, metal troughs and the like.
- (d) **Receptacles** intended for attachment plugs shall neither be placed in ironing-board cabinets nor in other like enclosures.
- (e) Floor-**receptacles** shall be of the waterproof, floor type unless, as in many cases in residences, danger from mechanical injury, and from the presence of water, is negligible.
- (f) Fuses shall not be used in rosettes.

- (g) No medium-base **lampholders** rated at less than 660 watts, 250 volts, are **approved** under this Code.
- (h) Key sockets (**lampholders**) shall not be installed over, or in dangerous proximity to, readily combustible material, nor where flyings of combustible material are present.
Under the above conditions, no **lampholder** shall be less than 7½ ft. above a floor unless it be individually controlled by a **switch**, or be otherwise so located or **guarded** as to prevent the lamp from being “backed out” by hand.
- (i) **Receptacles** installed in any location where there is more (electrical) danger to life and property than there would be under **ordinary conditions** (see Rule 904(a) (2)), and in every case where any of the **portable** appliances listed in Rule 904(a) (3) are used, or to be used, shall have an extra contact for **grounding**. Both **receptacles** and caps shall be polarized and shall be so constructed that they can be used only, respectively, with caps and **receptacles** of corresponding voltage rating.
- (j) **Lampholders**, if permanently connected to a supply circuit, e.g. in the case of drop cords and fixtures, shall be so wired that the **identified grounded conductor** is connected to the screw-shell binding post.
- (k) Devices with pin-type terminals shall be for temporary use only.

Note: It is strongly recommended that in damp places or other locations where lampholders would be exposed to mechanical injury, the outer case of such lampholders be of an insulating material that will resist mechanical shock.

Rule 2012

Gas-filled Incandescent Lamps

- (a) Incandescent lamps shall not be used in medium-base **lampholders** if rated at more than 300 watts, nor in mogul-base **lampholders** if rated at more than 1500 watts. For lamps rated at more than 1500 watts, special **approved lampholders** or other **approved** equivalent devices shall be used. Medium-base lamp bulbs of 300-watt capacity shall have a heat-deflecting disc or the equivalent.
- (b) Incandescent lamps shall not be located in show-windows nor where liable to contact with **flammable** material unless they are so installed (e.g. in **approved** fixtures equipped with shades or guards), as to operate at a safe temperature.
- (c) In show windows and show cases, **lampholders** having paper or fibre linings shall not be used.

Rule 2013

Arc Lamps

- (a) Arc lamps shall be equipped only with such resistances or regulators as are enclosed in **incombustible** cases, such resistances or regulators being treated as sources of heat. An incandescent lamp shall not be used as a resistance or regulator.
- (b) Arc lamps shall be equipped with globes and spark-arresters. The globe shall be guarded by wire-netting having a mesh not exceeding $1\frac{1}{4}$ in. The globe, netting, and spark-arrester, need not be used if the lamp be of the enclosed-arc type.
- (c) Outdoor arc lamps attached to a **building** and supplied from the interior installation shall be suspended at least 8 ft. above the ground level. Indoor arc lamps shall be hung **out-of-reach** or shall be suitably protected.
- (d) Leads to arc lamps shall have a current-carrying capacity approximately fifty per cent. (50%) in excess of the normal current of the lamp. If the leads are larger than No. 14 **B. & S. Gauge** and the lamp suspension provides for raising and lowering, they shall be stranded.
- (e) An **over-current device** shall be provided for each lamp or series of lamps.

Rule 2014

Mercury-vapour Lamps

- (a) Mercury-vapour lamps shall be equipped only with such resistances or regulators as are enclosed in **incombustible** cases, such resistances or regulators being treated as sources of heat. If these resistances or regulators be subject to flyings of combustible material they shall comply with applicable requirements of Section 32.
- (b) Except as provided in Clause (c), mercury-vapour lamps shall be connected to **branch-circuits** protected by **over-current devices** rated, or set, at not more than 15 amperes.
Note: See "Protection of Circuits"—Rule 803(c).
- (c) Mercury-vapour lamps may be *grouped* on a **branch-circuit** which does not supply any other devices provided that:—
 - (1) They are mounted in a single frame.
 - (2) Their aggregate capacity does not exceed 4,000 watts.
 - (3) They are connected in parallel.
 - (4) There are not more than 4 lamps in the group.
- (d) Fixtures carrying mercury-vapour lamps shall be wired with **conductors** not smaller than No. 12 **B. & S. Gauge**.

SECTION 30—ELECTRIC CRANES AND HOISTS

Rule 3001

(See also Rule 3203(p))

Collector Conductors

- (a) Collector **conductors** shall be secured at their ends by means of strain **insulators**, and bridge collector **conductors** shall be so mounted on **insulators** that the extreme limit of displacement of the **conductor** will not bring the latter to less than $1\frac{1}{2}$ in. from any adjacent surface.
- (b) Main collector **conductors** carried along runways shall be either attached to, or shall rest upon, **insulating** supports placed at intervals not exceeding 20 ft. If run in the same horizontal plane such **conductors** shall be separated not less than 6 in. except for monorail hoists for which a spacing of not less than 3 in. may be used; when run otherwise, the spacing shall be not less than 8 in. If necessary, intervals between **insulating** supports may be increased up to 40 ft., in which case the separation between **conductors** shall be increased proportionately. In no case shall the distance between parts of opposite polarity, and between **live** parts and **ground** when all "play" has been taken up in a direction which would decrease this distance, be less than 2 in.
- (c) Bridge collector **conductors** shall be kept at least $2\frac{1}{2}$ in. apart and, where the span exceeds 80 ft., **insulating** saddles shall be placed at intervals not exceeding 50 ft.
- (d) Collector **conductors** shall be not smaller in size than is specified in the following Table for various spans.

TABLE XXXII

SIZES OF COLLECTOR CONDUCTORS FOR CRANES AND HOISTS

Distance between Rigid Supports Feet	Size of Conductor Required B. & S. Gauge
0 to 30	6
31 to 60	4
over 60	2

*Note: The above Table does not take the current-carrying capacity of the **conductors** into consideration.*

- (e) Along runways **conductors** may consist of steel of rigid sections such as angles, tees, etc., firmly mounted on **insulating** supports spaced at intervals of not more than 20 ft. and such **conductors** shall be at least 1 in. distant from other **conductors** and conducting material. All sections of the **conductors** shall be mechanically and electrically connected to ensure electrical continuity.
- (f) Collector **conductors** shall be **inaccessible** to unauthorized persons.

Rule 3002

Control and Protection of Circuits

- (a) The main collector **conductors** shall be controlled by a **switch** located so as to be **readily accessible** from the floor and so that the collector **conductors** are visible from the **switch**. This **switch** shall be a **motor-circuit switch**.
- (b) A limit-**switch** shall be provided for the upper limit of travel of crane hoists.

Rule 3003

Grounding

- (a) Motor-frames, tracks and the entire frame of the crane shall be **grounded** as prescribed in Section 9.

SECTION 31—PASSENGER AND FREIGHT ELEVATORS

Rule 3101

General

Electrical equipment and wiring used in connection with elevators and dumbwaiters. (See also Garages,—Rule 3301).

- (a) **Elevator machinery** and its controlling and signalling equipment, except push-buttons and the like, shall be **inaccessible** to **unauthorised persons**.
- (b) The following minimum spacings shall be left around elevator control panels:

TABLE XXXIII

MINIMUM SPACINGS AROUND ELEVATOR CONTROL PANELS
(Exception: DUMBWAITERS)

Location	Space Inches
In front	36
On at least one side of a single panel	18
On the sides of a bank of panels	18
Behind the apparatus on the back of a panel	24

Note: This Clause is not intended to forbid the enclosing of the rear of control panels in steel cabinets but the provision of such enclosure shall not alter the application of the Rule.

- (c) An electric system having a rated (**system** or circuit) voltage in excess of 300 volts d.c. or a.c. shall have no part used for any control or operating circuit. Circuits of higher rated (**system** or circuit) voltage may, however, be used for the operation of motors, provided that all operating and signal wiring is thoroughly **insulated** from such power circuits and all machine frames and handropes are **grounded**.
- (d) A manually-operated multi-pole **isolating switch** shall be installed in the main power-supply line of each **electric elevator machine** or motor-generator set. This **switch** shall be located adjacent to and visible from the **elevator**

machine or motor-generator set. No provision shall be made for closing the **switch** from any other part of the **building**. When practicable, this **switch** shall be located in the machine room at the lock-jamb side of the entrance door.

- (e) Each drum type **electric elevator** (on which the lifting cables are positively anchored to the hoisting drum) driven by a polyphase motor shall be provided with a device which will prevent starting the motor if:—
 1. The phase rotation be in the wrong direction, or
 2. There be a failure in any phase.
- (f) Limit **switches** installed in **hoistways**, where moisture, water, dust or **hazardous** condition exists, which is liable to prevent the proper functioning of the **switch**, shall be so constructed and of such a type as will function correctly in the particular condition present.
- (g) All **live** parts of electrical apparatus in or on **elevator** cars or in **elevator hoistways**, shall be enclosed to prevent accidental contact.

Rule 3102

Conductors and Conduit

(See Rule 501)

- (a) **Elevator** circuits shall, in general, be run in **rigid conduit**. The **conduit** shall be equipped with **approved** terminal fittings having a single bushed opening for each **conductor** up to four in number. For more than four **conductors** the **conduit** may terminate in a bushing having a single opening, in which case the **conductors** shall be bunched, taped and coated with **insulating** paint. The **conduit** shall terminate as close to the **conductor** terminals as convenience will permit, but in no case shall the point of termination be nearer than 6 inches to the floor.

Note: The foregoing does not apply to signal wires receiving energy from either primary batteries or bell-ringing transformers.
- (b) The **conductors** between motors and control panel may be carried either in **rigid conduit** or separately supported on insulators or may be cabled together and taped or corded over all and finished with a suitable compound so as to form a rigid self-supporting cable. This cable shall not be more than (approximately) 3 ft. long and shall not be subjected to a temperature in excess of 50 deg. C., (122 deg. F.)

- (c) **Conductors** in **elevator hoistways** (exclusive of the travelling cables used as flexible connections between the car and the **rigid conduit** system) shall be run in **rigid conduit**, except that either **flexible conduit** or **armoured-cable** may be used between riser and limit switch, interlocks, push-buttons or similar devices. **Conductors** and travelling cables where attached to the car shall be run in **rigid conduit** or **metal raceways**. Short runs of **flexible conduit** or **armoured-cable** on the **elevator** car may be used provided that they are securely fastened. Split tees and elbows may be used on exposed **conduit** work, except where the **conduit** contains **feeders**.

Note: For control circuits in conduit, see Table X. Rule 601.

- (d) **Conductors** for **elevator** circuits—including operating, light, control and power **conductors**, and signal wires if these be an integral part of the wiring system—may be run in the same travelling cable or **conduit** system if the supply be taken from the same source of power. This may be done even though the voltage be altered within the **system** from the **elevator** power supply circuit, provided that all the **conductors** are **insulated** for the maximum voltage found in the **conduit** system and that the installation as a whole is **insulated** from **ground** for this maximum voltage.
- (e) **Conductors** of car-lighting circuits and of signal systems, if these be not an integral part of the **elevator** wiring system, shall be kept separate and run in separate travelling cables and **raceways**.
- (f) The flexible or travelling cables of the operating control and lighting circuits shall be Type “E” cord having a braid which is both flame-**retarding** and moisture-proofed.

Note: See Table XIV—“Flexible Cords”.

- (g) Electrical **conductors** and **conduits** shall not be installed in **elevator hoistways**, except as required to supply power, light, communications or signals for the operation of such **elevators**, and except that by **special permission** other **conductors** and **conduits** may be installed in existing **hoistways** where space conditions permit. Junction splice boxes in main **elevator feeder** runs and other permitted runs shall open outside the **hoistway**. **Conduits** shall be securely fastened to the **hoistway** construction. **High-potential conductors** shall not be installed in **elevator hoistways**. (*See Rule 5002 (j).*)

- (h) The minimum size of **conductors** shall be as follows:
- (1) For **elevator** operating and control **circuits**, No. 16 **B. & S. Gauge**. Such **conductors** shall be protected by **over-current devices** rated or set at not more than 6 amperes.
 - (2) For signal circuits, No. 18 **B. & S. Gauge**. Such **conductors** shall be protected by **over-current devices** rated or set at not more than 3 amperes.
 - (3) For lighting circuits, No. 14 **B. & S. Gauge**, except that for flexibility No. 16 **B. & S. Gauge** may in travelling cables be used in parallel.

Note: See "*Sizes of Conductors and Conduit*". Rule 601 (a).

- (i) **Conductors**, or groups of **conductors**, used for the operating and pilot circuits of **elevator** controllers, shall have an insulating, absorption-resisting, flame-retarding covering specially **approved** for this service.

Note: Until such coverings have been **approved**, rubber-covered **conductors** will be accepted.

For the particular service intended this requirement takes precedence over Rule 501(j).

SECTION 32—HAZARDOUS LOCATIONS***Classification of Hazardous Materials*****CLASSES I, II, III AND IV**

Equipment for use in hazardous locations is tested by laboratories according to classes of hazardous vapour, or gas and air, or dust and air, atmospheres, as follows:

CLASS I.

Group A—*Atmospheres containing acetylene.*

Group B—*Atmospheres containing hydrogen or gases or vapours of equivalent hazards such as manufactured gas.*

Group C—*Atmospheres containing ethyl ether vapour.*

Group D—*Atmospheres containing gasoline, petroleum, naphtha, alcohols, acetone, lacquer-solvent vapours, and natural gas.*

CLASS II.

Group E—*Atmospheres containing metal dust.*

Group F—*Atmospheres containing carbon black, coal or coke dust.*

Group G—*Atmospheres containing grain dust.*

CLASSES III AND IV—

Locations or atmospheres containing easily ignitable fibres or dust.

Rule 3201**General**

- (a) The requirements of this Section apply to locations in which the **Inspection Department** judges the apparatus and wiring to be subject to the condition indicated by the classifications applying thereto, and shall be considered to be additional to or amendatory of the requirements of other Sections in this Code covering ordinary installations.
- (b) The intent of this Section is to require a form of construction of equipment and of installation that will ensure safe performance under conditions of proper use and maintenance. It is, therefore, assumed that users will exercise more than ordinary care with regard to installation and maintenance.

- (c) In general it is desirable to reduce to a minimum the amount of **electrical equipment** used in **hazardous locations**, by installing therein only such equipment as is essential for the processes being carried on. **Service equipment, panelboards, switchboards**, etc., shall, where practicable, be located in rooms or sections of the **building** in which **hazardous** conditions do not prevail.
- (d) If walls and partitions, floors and ceilings, be used to form hazard-free rooms or sections they shall be of substantial construction, built of or lined with **incombustible** material and shall ensure that such rooms or sections will remain free from hazards. When communicating with a hazardous area, **fire-resisting** substantially dust-tight self-closing doors may be permitted in Class II, III, and IV locations.

*Note: It is recommended that static electricity be removed by permanent **ground** wires from such machines as would otherwise accumulate a charge, and from belts by means which do not embody any device or process which is liable to produce arcing or sparking save in a vacuum or some suitable enclosure.*

Rule 3202

Class I Locations

*Note: Class I locations are those in which **flammable** volatile liquids, highly **flammable** gases, mixtures (such as polishing pastes, etc.) or other highly **flammable** substances are manufactured, used, handled, or stored in other than their original containers.*

*This Class may include such locations as some parts of dry-cleaning and dry-dyeing plants, spray-painting establishments, **flammable-gas** plants, varnish manufacturing plants, distilleries, rectifying and blending plants producing whiskey and other alcoholic beverage liquors, plants producing industrial alcohol, and establishments or industries involving similar **hazardous** processes or conditions.*

Note: For Rules relating to Service or Filling Stations see Section 33.

- (a) In locations judged to be as described for Class I the following provisions shall be observed.
- (b) No **service equipment, switchboard or panelboard** shall be installed unless it be of a type **approved** for use in explosive atmospheres.

- (c) Wiring shall be enclosed in **rigid conduit with explosion-proof joints and fittings**.

Conduit, unless it be of the seamless type shall not be bent in the field; **conduit** bends shall be so labelled or marked as to show that they have been **approved** for use in explosive atmospheres.

If it be necessary to use flexible connections, as at motor terminals, **approved** flexible fittings of the **explosion-proof** type, shall be used.

At points where **conduit** terminates in an enclosure in which arcing or sparking is likely to occur, such as at motor terminals, **switch** boxes and the like, and wherever **conduit** runs from a **hazardous** to a non-**hazardous**—**location**, the **conduit** shall be sealed off by a sealing compound **approved** for the purpose, which is not affected by the surrounding atmosphere or liquids and which will not soften below 93 deg. C. (200 deg. F.). The sealing compound shall have a thickness of not less than 5/8 in.

Joints in **rigid conduit** made with threaded couplings shall have at least 5 threads engaged.

Rubber-covered **conductors** including those used for lighting-fixtures shall have a thickness of rubber not less than 3/64 in.

- (d) **Circuit-breakers** shall be of a type **approved** for use in explosive atmospheres. Fuses shall not be installed unless mounted within **explosion-proof** enclosures. The cutout bases and their enclosures shall be **approved** as unit devices for use in explosive atmospheres.
- (e) Transformers and capacitors containing a liquid that *will* burn in air, if located within **buildings**, shall be installed in a re-inforced concrete vault conforming to Rule 5004. The vault shall be provided with ample ventilation to remove **hazardous** vapours and with explosion-relief ducts. All vents and ducts shall be of reinforced concrete and this shall extend to a safe location outside the **building**. There shall be no opening from the vault to the interior of the **building**.

*Note: It is recommended that transformers and capacitors be located outside of the **building** proper and when so placed shall be so far away from explosive gases and vapours that a burn-out would not ignite them. The latter principle is applicable to loading docks and tank farms.*

Transformers and capacitors containing a liquid that *will not* burn in air may be:

- (1) located within the **hazardous** area provided that they have **explosion-proof** enclosures, or
- (2) installed so as, in effect, to be removed from the **hazardous location**.

- (f) Motors and generators shall be of types **approved** for use in explosive atmospheres.
- (g) Devices or apparatus such as motor controllers, thermal cutouts, **switches**, relays, the **switches** and contactors of auto-transformer starters, resistance or impedance devices, which tend to create arcs, sparks, or high temperatures, shall not be installed unless such devices or apparatus are of a type **approved** for use in explosive atmospheres. **Switches**, controllers and other equipment requiring manual operation shall be externally operable.

*Note: It is recommended that, where practicable, such equipment be located outside of the **hazardous** area (see Rule 3201-d) and that where, as in the case of motor controllers, it is necessary that the equipment be controlled from a point inside the **hazardous** area, a suitable form of **explosion-proof** master **switch** be located inside the area to effect the operation of the equipment.*

- (h) Electric heating appliances shall be of a type **approved** for the particular location.
- (i) **Switches** controlling lighting circuits shall not be installed unless they are of a type **approved** for use in explosive atmospheres.
- (j) **Electrical equipment** shall be so marked as to indicate that it has been **approved** for use in explosive atmospheres.
- (k) Sufficient general illumination shall be provided by fixed lighting units to eliminate, so far as is practicable, the need for **portable** lamps. Both fixed and **portable** lamps shall be enclosed in a manner **approved** for explosive atmospheres and shall be protected against breakage where necessary, by **approved** types of guards. **Lampholders** shall not be of the pendant type unless supported by and supplied through hangers of **rigid conduit**, or flexible connectors of a type **approved** for use in explosive atmospheres. Rigidly mounted fixtures shall be strongly supported. **Lampholders** for **portable** lamps shall be of the moulded-composition, keyless type with no exposed metal parts.

Portable lamps shall operate—

- (1) from **ungrounded** low-voltage circuits having inherent current-limiting characteristics or,
 - (2) If of the line-voltage type shall be so designed that **grounded** non-current-carrying metal parts will not form a path to earth through other **grounded** metal with which the assembly may be in contact.
- (l) Where flexible cord is required for **portable** lamps etc. it shall be of Type "S" and shall contain one extra **insulated conductor** to form a **grounding** connection for metal lamp guards, motor frames, and all other exposed metal portions of **portable** lamps and devices.
- Cords connected directly to supply **conductors** shall be securely supported so that the probability of a break in the **conductors** at this point will be minimized.
- (m) **Receptacles** and attachment plugs shall be so connected as a part of an **approved** unit device with an **explosion-proof** interlocking **switch** that the plug cannot be removed while the switch is in the "on" position, or **approved** devices in which the current is broken in an **explosion-proof** enclosure shall be used. Such **receptacles** and plugs shall be of the polarized type which automatically provides a connection for the **grounding conductor** for the flexible cord.
- (n) The exposed non-current-carrying metal parts of equipment, fixed or **portable** appliances, fixtures, **cabinets**, cases, and **conduit** shall be **grounded**.
- (o) There shall be no **exposed live** parts.

Spray Booths

- (p) Electrical apparatus, except as to modifications allowed in Clauses (s), (t) and (u) shall be in strict accordance with the foregoing Clauses of this Rule. However, such special electrical equipment may be required beyond the area defined in Clause (s) if the occupancy, other than spraying, is such as to create an extension of this **hazardous** area. **Inspection Departments** shall be consulted as to the limits of the areas and locations where electrical apparatus shall conform to the Rules covering Class I locations.

- (q) Where practicable, the use of **portable** lamps shall be avoided. If conditions be such that fixed lighting will not satisfactorily produce sufficient illumination on the object being sprayed, then a **portable** lamp wired with 3-**conductor** Type "S" cord (one **conductor** to be used for **grounding** non-current-carrying metal parts) and **approved** for the location, may be used, provided that it is securely mounted on a standard or pedestal, which in turn is securely fastened to a heavy base at least 16 in. in diameter.
- Note: The object of the foregoing is to minimize breakage of lamps due to accidental upsetting.*
- (r) No lamps, motors, or electric varnish-heaters shall be located inside spray booths, hoods, or ducts, or in any location where there is a possibility of the spray coming into direct contact with the above-mentioned equipment.
- (s) Lamps and motors shall not be located within a distance of 20 ft. from the face of a spray booth, unless they conform to Rules 3202 (t) and 3202(u).
- (t) Motors within the location defined in Clause (s) shall be of one of the following types:—
- (1) The type **approved** for use in explosive atmospheres.
 - (2) Any **approved enclosed** type.
 - (3) Either the **open** or the **protected** type of induction motor having no brushes, make-and-break contacts, collectors or other arcing or sparking parts.
- (u) Lamps within the location as defined in Clause (s) shall either be of the type **approved** for explosive atmospheres or of the enclosed "vapour-tight" type.
- (v) When spray painting is carried on in a room not provided with a ventilated booth or hood the entire room shall be considered as being a **hazardous location**.

Rule 3203

Class II, III and IV Locations

Notes: (1) Class II locations are those in which (i) combustible dust is thrown, or is likely to be thrown, into suspension in the air in sufficient quantities to produce explosive mixtures, or (ii) those where it is impracticable to prevent such combustible dust from collecting in such quantities on or in motors, lamps or other electrical devices that they are likely to become overheated because normal radiation is prevented.

*This Class may include such locations as some parts of flour mills, feed mills, grain elevators, starch plants, sugar, cocoa, and coal pulverizing plants, and establishments or industries involving similar **hazardous** processes or conditions.*

(2) *Class III locations are those in which easily ignitable fibres or materials producing combustible flyings are handled, manufactured or used, and which are **hazardous** through such fibres or flyings collecting on or being ignited by arcing contacts, resistors, lamps or similar apparatus.*

*This Class may include locations such as some parts of cotton and other textile mills, combustible fibre manufacturing plants, cotton gins, clothing manufacturing plants, cotton-seed mills, woodworking plants and establishments or industries involving similar **hazardous** processes or conditions.*

(3) *Class IV locations are those in which easily ignitable combustible fibres are stored or handled (except in rooms where such fibres are in process of manufacture) and which are **hazardous** through such fibres being ignited by arcing contacts, resistors, lamps or similar apparatus.*

This Class may include locations such as warehouses in which are stored or handled combustible fibres such as cotton (including cotton linters and cotton waste) sisal or henequen, istle, jute, hemp, tow, coca, fibre, oakum, baled waste, kapok, Spanish moss, excelsior, and other similarly readily ignitable fibres.

- (a) Where conditions are judged by the **Inspection Department** to be as described in Classes II, III and IV the following provisions shall be observed.
- (b) **Service** equipment, **switchboards** or **panelboards** shall not be installed unless all **live** parts are enclosed in **dust-tight** metal enclosures or cabinets with provision for external operation only.
- (c) Wiring shall be enclosed in **rigid conduit**. If it be necessary to use flexible connections, as at motor terminals or elsewhere, a short length of flexible steel **conduit**, which shall be bonded may be used.

Conduit boxes and other fittings in which arcing or sparking may occur or which are used in locations where dusts are of an electrically conducting nature, shall be of the **dust-tight** type. **Conduit** boxes and other fittings for Class II locations shall have threaded hubs to receive the **conduit**.

Rubber-covered **conductors** shall have a thickness of rubber not less than 3/64 in.

Note: It is recommended that pilot lights be installed on the outside of storage rooms to indicate whether the current in the room is "on" or "off".

- (d) **Circuit-breakers** shall be of an **approved dust-tight** type. Fuses shall not be installed unless mounted within **dust-tight** enclosures. The cutout bases and their enclosures shall be **approved** as unit devices.
- (e) Motors and generators shall be of **approved dust-tight** types.
If motors and generators of the **enclosed**, pipe-ventilated, types are used, both the inlet and outlet vents shall extend to a source of clean air by means of metal pipes substantially constructed with each section attached to the next by welding, rivetting or other approved means. The outer ends of vent pipes shall be suitably screened to prevent the entrance of animals or birds, and rain and snow, as far as practicable. If motors or generators are intended to be moved on their bases, a slip or universal joint tight enough to prevent the entrance of dust shall be provided in the vent pipes.
- (f) Devices or apparatus such as motor controllers, thermal cutouts, **switches**, relays, the **switches** and contactors of auto-transformer starters, resistance and impedance devices, which tend to create arcs, sparks, or high temperatures, shall not be installed unless such devices or apparatus are of an **approved dust-tight** type or are suitably enclosed in **dust-tight cabinets**. **Switches**, controllers, and other equipment requiring manual operations shall be externally operable without opening enclosures.
- Note: It is recommended that, where practicable, such equipment shall be located outside of the **hazardous** area (See Rule 3201 (a)), and where, as in the case of motor controllers, it is necessary that the equipment be controlled from a point inside the **hazardous** area, a suitable form of **dust-tight master switch** be located inside the area to effect the operation of the equipment. Where magnetic separators are used in conjunction with grinding of grain, starch, sugar or other similar materials, it is recommended that the grinder motor control be so inter-locked with the magnet circuit of the separator that the motor cannot be energized if the magnet circuit is open. Motor controls for grinders should be so located with reference to exits that the machine may be shut down in the event of explosion or fire, without danger to the operator.*
- (g) It is recommended that transformers and capacitors embodying the use of oil be located outside the **building** proper and in such a manner that they and their combustible supports are at least 10 ft. distant horizontally from any exposed combustible parts or unprotected openings of **buildings**.

Transformers and/or capacitors embodying the use of a liquid which will burn, shall be installed within a reinforced concrete vault conforming to Rule 5008 of this Code. Such a vault shall be provided with air cooling and pressure relief openings of non-combustible construction extended to the outside of the **buildings**. Any openings from a vault into the **building** shall be protected by double **approved fire-doors**.

Transformers and/or capacitors containing a liquid which will not burn shall either be of **dust-tight** construction with **dust-tight** terminal enclosures, or they shall be installed within a vault required by the preceding paragraph, or a **fire-resistive** room which is constructed so as to adequately exclude process dust or combustible flyings and which is fitted with **approved fire-doors**.

- (h) Electric heating appliances shall be of types **approved** for the particular location.
- (i) **Switches** controlling lighting circuits shall not be installed unless they are of an **approved dust-tight** type.
- (j) **Electrical equipment** shall be so marked as to indicate that it has been **approved** for use in the particular location.
- (k) Sufficient general illumination shall be provided by fixed lighting means to eliminate, so far as is practicable, the need for **portable** lamps. Both fixed and **portable** lamps shall be enclosed in **approved dust-tight** enclosures. **Approved** guards shall be supplied for all **portable** lamps and for all fixed lamps where exposed to mechanical injury. Lamps shall not be so installed as to be exposed to injury when bales are being tiered or handled. Lamps of the pendant type shall be supported by and supplied through **approved dust-tight** hangers of **rigid conduit**, or flexible connectors. If fixtures be rigidly mounted, supports of adequate strength shall be provided. **Lampholders** for **portable** lamps shall be of the moulded-composition keyless type with no exposed metal parts.

In Class II locations, if light be required for the interior of bins, hoppers, elevators, conveyors, and similar equipment or construction, such light shall, if practicable, be supplied by lamps enclosed in **dust-tight** globes properly protected against mechanical injury and mounted flush in the walls, ceiling, or floors of the equipment or construction. Wiring or fixtures shall not be permitted inside of bins, hoppers, **elevators**, or conveyors.

- (l) Where flexible cord is required for **portable** lamps, etc., it shall be of Type S and shall contain one extra **insulated conductor** to form a **grounding** connection for metal

lamp guards, motor frames and all other exposed metal portions of **portable** lamps and devices.

Portable cords connected direct to supply **conductors** shall be securely supported so that the probability of a break in the **conductor** at this point will be minimized, and shall be provided with a switching device in the supply **conductors**.

- (m) **Receptacles** and attachment plugs shall be of an **approved** type which confines any arc by means of a **dust-tight** enclosure. Such **receptacles** and plugs shall be of the polarized type that provides a connection for the **grounding conductor** of the flexible cord.

Note: It is recommended that attachment plugs and receptacles be so connected, as a part of a unit device, with a dust-tight, interlocking switch, that the plug cannot be inserted or removed while the switch is in the "on" position.

- (n) The exposed non-current-carrying metal parts of equipment, fixed or **portable** appliances, fixtures, cabinets, cases and **conduit** shall be **grounded**.

- (o) There shall be no **exposed live** parts except as permitted for electric cranes in Classes III and IV.

- (p) Electric cranes may be installed in Classes III and IV locations under the following conditions. Electric cranes operating over combustible fibres shall not be operated on a system with a **grounded conductor**. **Feeders** for electric cranes shall be furnished with a recording **ground-detector**, and protected by a relay which will automatically open the **feeder circuit-breaker** in the event of the **insulation** of the system falling below 1000 ohms. Bare **conductors** for cranes operating in rooms used for the storage of combustible fibres shall be protected by suitable barriers so arranged as to prevent any escape of sparks or hot particles and the moving current-collectors shall be so designed as to minimize sparking at sliding contacts.

Note: It is recommended that, where the distance of travel permits, current to the crane be supplied through Type S. flexible conductors equipped with an approved reel or take-up device.

- (q) Electric trucks shall be used only in Class IV locations and shall have wheels equipped with rubber tires or made of non-conducting material. Electric trucks shall have their batteries charged only in rooms meeting the requirements of the following Clause.

- (r) Storage-battery charging equipment shall be located in separate rooms built of or lined with substantial **incombustible** materials so constructed as adequately to exclude flyings or lint, and shall be well ventilated.

SECTION 33

GARAGES AND SERVICE OR FILLING STATIONS

Rule 3301

General, Wiring and Equipment

Note: The intent of this Section is to require a form of construction of equipment and of installation that will ensure safe performance under conditions of proper use and maintenance. It is, therefore, assumed that users will exercise more than ordinary care with regard to installation and maintenance.

*In general, it is desirable to reduce to a minimum the amount of **electrical equipment** used in these locations by installing therein only such equipment as is essential for the work being carried on. It is recommended that service equipment, **panelboards, switchboards, etc.**, be located, where practicable, in rooms or section of the **building** in which the definition does not apply, when such equipment may be of the types **approved** for such locations.*

- (a) In **garages** and **service or filling stations** as defined in this Code the apparatus and wiring shall be subject to the following provisions which shall be considered as additional to or amendatory of the requirements of other Sections in this Code covering ordinary installations.
- (b) In certain portions of such premises conditions are liable to be such as to create a **hazard** similar to that encountered in Class I locations and in these portions of such premises especially in pits or other depressions such as spaces beneath gasoline pumps, where vapours may collect, the provisions of Rule 3202 shall be complied with.
- (c) The wiring method shall be as follows:—
 - (1) In a **garage** that will not accommodate more than two vehicles any wiring method specified in Section 5 may be used.
 - (2) If the floor area be sufficient to accommodate more than two vehicles wiring shall be in **conduit, surface metal raceways, armoured-cable, wireways, or busways.**
- (d) Equipment in which arcing or sparking may occur shall conform to the following:
 - (1) Fixed generators or motors having commutators, collector rings, or other make-and-break or sliding contacts, if located within 4 ft. of the floor, shall be of **approved** enclosed types.

- (2) Control equipment shall not be located within 4 ft. of the floor.
- (3) **Over-current devices, switches, receptacles, fixed lampholders** and charging panels shall not be located within 4 ft. of the floor.
- (4) Gasoline pumps, or other equipment handling gasoline, which within their pedestals are wired for electric current, shall be wired in **rigid conduit**. All joints in such **conduit** and all electrical fittings and devices of any description forming a part of the assembly shall be **approved** for use in Class I locations.

(e) Types of flexible cords shall be as follows:

- (1) For pendant lamps—Type K or S.
- (2) For **portable** lamps and equipment—Type S.
- (3) For battery-charging—Type S.

Flexible cord, and devices used with such cord, shall conform to Rule 904(a)(3).

(f) Cords used for the connection of **portable** appliances shall carry the male end of a polarity-type pin-plug connector or equivalent: the female end being of such design, or so hung, that the connector will break apart readily at any position of the cable. The connector shall be kept at least 4 ft. above the floor.

(g) **Lampholders** of fixtures and pendant lamps shall be connected in conformity with Rule 2010. **Portable** lamps shall be equipped with handle, **lampholder**, hook and substantial guard attached to the **lampholder** or the handle. **Lampholders** shall be keyless and of moulded composition, metal-sheathed porcelain, or other types **approved** for the purpose.

(h) **Live** parts of equipment shall be **guarded** to prevent accidental contact therewith.

(i) All metallic **conductor** enclosures and exposed metal parts of fixed equipment, except pendant lamps operating at not more than 150 volts, shall be **grounded** in conformity with Section 9.

SECTION 34

WHERE EXCESSIVE MOISTURE OR CORROSIVE
LIQUIDS OR VAPOURS ARE PRESENT

Rule 3401

General, Wiring, and Equipment

*Note: This Section covers locations in which moisture in the form of vapour or liquid is present in quantities which would be liable to interfere with the normal operation of **electrical equipment**: it includes locations where apparatus or wiring may be subjected to condensing of moisture, or to dripping or splashing of liquid, such as:*

<i>Basements (other than in dwelling houses)</i>	<i>Dairies (Commercial and Farm)</i>
<i>Abattoirs</i>	<i>Dye Works</i>
<i>Bath Houses</i>	<i>Ice Plants</i>
<i>Bottling Works</i>	<i>Ice Cream Plants</i>
<i>Breweries</i>	<i>Laundries (Commercial)</i>
<i>Cold Storage Plants</i>	<i>Packing Plants</i>
<i>Canneries</i>	<i>Stables</i>

The intent of this Section is to require a form of construction of equipment and of installation that will ensure safe performance under conditions of proper use and maintenance, it is, therefore, assumed that users will exercise more than ordinary care with regard to installation and maintenance.

- (a) Where moisture is present, either in the form of vapour or liquid, in quantities which would be liable to interfere with the normal operation of **electrical equipment**, the apparatus and wiring shall be subject to the following provisions, which shall be considered as additional to or amendatory of the requirements of other Sections in this Code covering ordinary installations.
- (b) In general, it is desirable to reduce to a minimum the amount of **electrical equipment** used in these locations by installing therein only such equipment as is essential for the process being carried on. Service equipment, **panelboards, switchboards**, etc., shall, where practicable, be located in rooms or sections of the **building** in which the conditions as mentioned above do not obtain when such equipment may be of the types **approved** for such locations.

- (c) Wiring may be enclosed in **rigid conduit**, or lead-covered **armoured cable**, non-metallic sheathed cable, or open wiring, may be used. Open wiring shall be adequately protected against mechanical damage. Drip-loops shall be provided on **conductors** wherever moisture could run along **conductors** and enter any fitting or bushing, unless such fitting or bushing be effectually sealed. All joints in **conduit** shall be made **water-tight**. Woodwork used in the construction of guard strips, boxing for **conductors**, etc., shall be well coated with moisture-proof paint. Split knobs (so-called) shall not be used. When non-metallic sheathed cable is used it shall be kept away from wet surfaces by suitable means. In locations referred to in Rule 3401 (d) **conductors insulated** with varnished cambric shall not be used.

*Note: As an alternative to the above, **conduit** may be so arranged as to drain at frequent intervals to convenient locations, and be equipped with suitable fittings which will allow the moisture to drain out of the system.*

- (d) Motors, generators, controllers, **circuit-breakers**, fuse cutouts and other equipment shall be provided with enclosures of **water-tight**, splash-proof, or drip-proof construction as may be required for the particular installation and particular location of the apparatus involved. If apparatus be liable to be partially submerged or subject to direct streams of liquid under pressure, enclosure shall be **water-tight**. If apparatus be liable to be subjected to splashing of water from floor or walls, enclosures shall be splash-proof. If apparatus be liable to be exposed only to falling or condensing moisture, drip-proof enclosures shall be used. **Switches**, controllers and other equipment requiring manual operation shall be externally operable.

If **electrical equipment** be liable to be exposed to the action of corrosive liquid or gases, all metal parts either shall be made of non-corrodible metal or shall be substantially plated or coated with permanent non-corrodible material.

Screws or bolts used for securing **electrical equipment** in place shall be made of non-corrosive metal.

- (e) Circuits shall, where practicable, be so arranged that current may be entirely cut off from a point outside the area.

- (f) **Lampholders** shall be of weather-proof, keyless type and if not attached to fixtures, shall be hung by separate stranded, rubber-covered **conductors** not smaller than No. 14 **B. & S. Gauge**. The pendant **conductors** shall be **soldered** directly to the **branch-circuit conductors** and supported independently of them. Pendant **conductors** over 3 feet long shall be twisted together. **Lampholders** for **portable** lamps shall be of the moulded-composition, keyless type with no exposed metal parts.
- (g) Where flexible cord is required for **portable** lamps, etc., it shall be of Type S, K or PAWP and shall contain one extra **insulated conductor** to form a **grounding** connection for metal lamp-guards, motor frames and all other exposed metal portions of **portable** lamps and devices.
- (h) The exposed non-current-carrying metal parts of equipment, whether fixed or **portable**, appliances, fixtures, cabinets, cases, and **conduit**, shall be **grounded** as required by Section 9.
- (i) **Live** parts of equipment shall be **guarded** to prevent accidental contact therewith.

SECTION 35

MOTION-PICTURE STUDIOS AND PROJECTORS

Rule 3501

General, Wiring, and Equipment

- (a) The requirements of this Rule shall apply to motion-picture studios, exchanges, factories, and laboratories, and to that **building** or portion of a **building** in which motion-picture films are manufactured, exposed, developed, printed, rewound, repaired or stored. This Rule shall not apply where only approved slow-burning (cellulose-acetate or equivalent) film is used.
- (b) The wiring method shall be **rigid conduit**.
Note: Portable cables or flexible cord may be used on studio stages and at other locations where fixed wiring methods are impracticable.
- (c) Lamp **outlets** on walls shall consist of **lampholders** mounted in **outlet** boxes and equipped with open-end guards riveted to the cover of the box.
- (d) Pendant lamps shall be suspended by means of reinforced cord, **armoured** cord, or **armoured cable**, and shall be protected by lampguards.
- (e) At patching tables, composition, or metal-sheathed porcelain, keyless **lampholders** shall be employed and shall be equipped with guards to protect the lamps from mechanical injury.
- (f) In film-storage vaults lamps shall be installed on rigid fixtures and enclosed in vapour-tight globes. Lamps shall be controlled by a double-pole **switch** located outside the vault. Neither electric motors nor **portable** lamps shall be placed in the vault.
- (g) For **portable** lamps, composition, or metal-sheathed porcelain, keyless **lampholders** shall be used. The cord shall carry the male end of a pin-plug connector or equivalent, the female end being of such design or so hung that the connector will readily break apart at any position of the cord. The connector shall be kept at least 1 ft. from the floor. The **lampholder** shall be provided with a guard, hook and handle. The provisions of this Section shall not apply to **portable** lamps used as properties in a motion-picture set on a studio stage or similar location.

- (h) Type S cord shall be used on **portable** lamps and equipment.
- (i) Motors or generators having brushes or sliding contacts shall be of **approved dust-tight** or **enclosed** types. This requirement shall not apply to motors or generators used on studio stages but the **live** parts of such machines shall be **guarded** or enclosed in accordance with Clause (l).
- (j) **Switches** shall be of the externally operable type.
- (k) All metallic **conductor** enclosures and the exposed metal parts of fixed equipment, except pendant lamps operating at not more than 150 volts, shall be **grounded** in conformity with Section 9.
- (l) **Live** parts shall be enclosed to prevent accidental contact therewith. Rheostats shall be enclosed and externally operable.

Rule 3502

Motion-picture Projectors

- (a) Projectors shall be **approved** for the purpose as an assembly or shall comply with both of the following conditions:
 - (1) An **approved** projector shall be used.
 - (2) An approved projector lamp shall be used.
- (b) **Conductors** supplying **outlets** for projectors of the professional type shall not be smaller than No. 4 **B. & S. Gauge** and shall be of sufficient size for the projector employed.
- (c) Asbestos-covered **conductors** shall be used on arc lamps and other equipment where the ambient temperature at the **conductor** as installed will exceed 50 deg. C. (122 deg. F.).
- (d) Hard-service cords, Types K, S or SJ shall be used on **portable** equipment.
- (e) Incandescent lamps in projection rooms or booths shall be provided with an **approved** lamp guard unless otherwise protected by **incombustible** shades or other enclosures.
- (f) Motor-generator sets, transformers, rectifiers, rheostats, and similar equipment for the supply or control of current to arc lamps or projectors shall, if practicable, be located in separate rooms. If placed in the projector room they shall be so located or **guarded** that arcs or sparks cannot come into contact with film, and motor-generator sets shall comply with Rule 3501 (i).

Rule 3503

Sound-recording and similar Equipment

Note: This Rule applies to installations of equipment and wiring used for sound recording and reproduction, centralized distribution of sound, public address, speech-input systems and electronic organs.

- (a) Except as modified by this Rule, wiring and equipment from the source of power to and between devices connected to an interior wiring **system** shall comply with the requirements of this Code covering the particular locations involved.
- (b) **Conductors of different systems** grouped in the same **conduit** or other metallic enclosure, or in **portable** cords or cables, shall comply with the following requirements:
 - (1) Power-supply **conductors** shall be properly **identified** and shall be used solely for supplying power to the equipment to which the other **conductors** are connected.
 - (2) Input leads to a motor-generator or rotary-converter shall be run separately from the output leads.
 - (3) The **conductors** shall be **insulated** either individually, or collectively in groups, by **insulation** at least equivalent to that on the power-supply and other **conductors**, except where the power-supply and other **conductors** are separated by a lead sheath or other continuous metallic covering.
 - (4) Flexible cords and cables shall be of Types P, K, S, SJ or other types specifically **approved** for the purpose for which they are to be used. The **conductors** of flexible cords, other than power-supply **conductors**, may be of a size not smaller than No. 26 B. & S. Gauge provided that such **conductors** are not in direct electrical connection with the power-supply **conductors** and are equipped with current-limiting means so that the maximum power under any condition will not exceed 150 watts.
 - (5) Terminals shall be marked to show their proper connections. Terminals for **conductors** other than power-supply **conductors** shall be separated from the terminals of the power-supply **conductors** by a spacing at least as great as that between power-supply terminals of opposite polarity.

(c) Storage batteries shall comply with the following:

- (1) Storage batteries shall be installed in accordance with Rule 2006.
- (2) Storage-battery leads shall be rubber-covered, Type R.
- (3) Overcurrent protection shall be provided as follows:
 - (i) "A" circuits, when supplied by lighting **branch-circuits**, or by storage batteries of more than 20 ampere-hour capacity, shall have overcurrent protection not exceeding 15 amperess.
 - (ii) "B" circuits shall have overcurrent protection not exceeding 1 ampere. The overcurrent protection shall be placed in each positive lead.
 - (iii) "C" circuits may be without overcurrent protection.
 - (vi) Overcurrent devices shall be located as near as practicable to the battery.

SECTION 36

ELECTRICALLY-OPERATED PIPE ORGANS

Note: The following Rule applies only to those electrical circuits and parts of electrically operated organs which are employed for the control of the sounding apparatus and keyboards.

Rule 3601

General

- (a) The source of energy shall be either a self-excited generator or a primary battery, and the operating potential shall not exceed 15 volts.
- (b) Unless the generator and motor frames be **grounded** they shall be **insulated** both from each other and from **ground**.
Note: See "Exposed Non-current-carrying Metal Parts" Rule 904 (c).
- (c) All **conductors**, except common-return **conductors** and those inside the organ proper, the organ sections, and the organ console, shall be cabled.
- (d) The separate **conductors** of the cable shall be not smaller than No. 26 **B. & S. Gauge** and shall have either rubber, cotton, or silk **insulation**. The cotton or silk may be saturated with paraffin if desired.
- (e) The separate **conductors** shall be covered with one or more braided outer coverings. A tape may be substituted for an inner braid.
- (f) The separate **conductors**, if not required by Clause (c) to be cabled, shall be bunched. The outside covering of a cable not run in **conduit** shall either be flame-retarding or the cable shall be covered with a closely-wound fireproof tape.
- (g) The common-return **conductor** shall be not smaller than No. 14 **B. & S. Gauge**. It shall be of either the rubber covered (R) or slow-burning (SB) type and shall not be contained in the cable. It may be taped to the cable or placed under an additional covering enclosing both cable and return **conductor**.
- (h) All wiring and devices, within the organ or any of its parts, shall be neatly disposed and securely fastened.
*Note: It is not found to be either necessary or feasible in organ structures to require the use of **incombustible absorption-resisting insulating** material for the support or enclosure of current-carrying parts, but **metal raceway** may be used if desired.*
- (i) Circuits shall be so subdivided, and protected near to the source of current by enclosed fuses of not over 15 amperes capacity, that every **conductor** will be protected by one or other of such fuses.

SECTION 37—RADIO INSTALLATIONS

Note: Nothing in this Code shall be construed as relieving any person from the necessity of procuring a license from the Radio Branch of the Department of Transport, Ottawa, or from complying with any of the Rules and Regulations of that Branch.

Note: The requirements of this Section do not apply to equipment installed on board ship or to antennae used for coupling carrier-current to line-conductors.

Rule 3701

General

- (a) All **electrical equipment** pertaining to, or used in conjunction with, radio installations, shall conform to the Rules and Regulations contained elsewhere in this Code in so far as they apply and also to the following special requirements.
- (b) Antenna supports shall be located not less than 10 ft., measured horizontally, from the nearest light, power or telephone **conductors**.
- (c) Antennæ, counterpoises and lead-in **conductors** outside of **buildings** shall not cross over any street or lane, nor be erected at any point where they would cross over or under electric light or power circuits of more than 750 volts.
- (d) **Receptacles** and attachment plugs shall be of a type specially **approved** for this service.

SECTION 38—SIGNS AND OUTLINE LIGHTING

Rule 3801

General

- (a) The potential between any **conductor** and **ground** shall not exceed 150 volts.
- (b) **Conductors** of the rubber-covered (R) type shall be used.
- (c) **Conductors** shall be **soldered** to terminals of **receptacles** and **exposed** parts of **conductors** and terminals shall be treated to prevent corrosion.
- (d) Sign leads, where passing through walls and partitions of the sign structure, shall be protected by **incombustible, absorption-resisting** bushings.
Note: Sign leads may be cabled if run as open wiring.
- (e) Wiring, irrespective of the number of **outlets**, shall be subdivided into **branch-circuits** which can be properly protected by **over-current devices** rated, or set, at not more than 15 amperes and such **over-current devices** shall not protect any other circuit.
- (f) Signs and outline lighting shall be so located that any person working thereon will not be liable to come in contact with overhead **conductors**.
Note: The following Clauses are primarily for field use.
- (g) Sheet metal used in the construction of sign boxes and outline troughs shall be not less than No. 28 U.S. **Sheet-metal Gauge**. It shall be galvanized, treated with at least three coats of anti-corrosive paint, or otherwise suitably protected from corrosion.
- (h) With the exception of wood employed for the external decoration of signs and kept at least 2 in. distant from the nearest **lampholder**, signs shall be constructed entirely of metal or other approved **incombustible** material.
- (i) The design shall be such as to afford ample strength and rigidity to render the box or trough practically weather-proof, to enclose all terminals and wiring other than the leads, and to provide drainage for each compartment by means of one or more holes, each not less than $\frac{1}{4}$ in. in diameter.
- (j) A separate, completely enclosed, **accessible approved** box or **cabinet** shall be provided to contain **over-current devices**, flashers, non-weatherproof transformers or other similar devices placed on or within the body or structure of a sign, or on the exterior of a **building**.
- (k) **Surface raceways** shall not be employed.
- (l) Fixed signs shall be **grounded** in accordance with the requirements of Section 9.

Rule 3802

Outline Lighting

- (a) **Conductors** shall be run as open-wiring, in **rigid conduit**, or in metal troughs; or lead-sheathed **armoured-cable** shall be used.
- (b) If wired in **rigid conduit or armoured-cable**, each **lamp-holder** shall be installed in its own individual **outlet box**. If metal troughs be used, the **lampholders**, together with the wiring shall be installed therein.
- (c) Sheet steel used for troughs shall be of not less than No. 28 **U.S. Sheet-metal Gauge**. Having regard to their general construction and the conditions to which they are liable to be subjected in use, troughs shall be of ample strength and rigidity and shall be treated to prevent rusting.
- (d) If open-wiring be employed, a *minimum* distance of 1 in. shall be maintained between the **conductors** and adjacent surfaces. If **flexible tubing** be required, it shall be kept at least $\frac{1}{2}$ in. from adjacent surfaces and the end shall be sealed, and painted with moisture **repellant**.
- (e) **Lampholders** shall be of such type and so installed that they cannot turn and that their terminals will be at least $\frac{1}{2}$ in. from adjacent conducting material and from the terminals of adjacent **lampholders**. If open-wiring be employed this separation shall be at least 1 in.
- (f) For open-wiring in those parts of circuits where **conductors** are connected to **lampholders** which hold the **conductors** at least 1 in. from adjacent surfaces and which are placed not over 12 in. apart, such **lampholders** shall be considered as affording the necessary support and spacing for the **conductors**.
- (g) If **lampholders** be spaced more than 12 in. apart, the **conductors** shall be supported on **incombustible absorption-resisting insulators** at intervals not exceeding 12 in.
- (h) In open-wiring a separation of $2\frac{1}{2}$ in. shall be maintained between **conductors**, except where separation is provided by **lampholders**.
- (i) **Lampholders** shall be keyless and shall be of porcelain or other approved **insulating** material.
- (j) Miniature **lampholders** shall not be used without **special permission**.
- (k) Circuits shall be so arranged that the number of **outlets** and the lamps connected to them shall in no case be such as to cause more than 15 amperes to pass through the **branch-circuit fuse**.

SECTION 39—THEATRE INSTALLATIONS

Rule 3901

General

Note: See "Sizes of Conductors and Conduit"—Rule 601.

- (a) **Live** parts of either permanent or temporary wiring and equipment shall not be **exposed**.
- (b) Wiring, except as may otherwise be permitted for temporary work, or if the use of flexible cord be permitted, shall be in **rigid conduit**; or, by **special permission**, **flexible conduit** or **armoured-cable** may be used. **Surface-raceways** shall not be used on the stage side of the proscenium wall.
- (c) **Electrical equipment** carried by travelling companies shall not be used, for the initial performance of any "Stand", until a permit has been obtained from the **Inspection Department**.

Note: This requirement applies also to circuses and other travelling shows not necessarily held within a regular theatre. A permit issued prior to inspection may be cancelled if inspection reveals unsatisfactory conditions.

- (d) An **emergency lighting system** conforming to the requirements of Section 40 hereof, shall be installed and maintained in all **buildings** used as **theatres** or motion-picture halls, where the seating capacity of the auditorium exceeds the amount necessary for 100 persons.

Rule 3902

Switchboards, Portable and Stationary

- (a) **Switchboards** shall be of the **dead-front** type and shall be protected above with a suitable metal guard or hood extending the full length of the board and completely covering the space between the wall and the board to protect the latter from falling objects.
- (b) Two extra **service boxes** shall be provided, suitably located, one at each end of the stage, in order to furnish proper and convenient means of supplying current to extra equipment. These boxes shall be connected to the (main) **service**, or to some entirely separate source of supply, in a permanent manner; they shall also, whether made for 2- or 3-wire

circuits, have a capacity of not less than 400 or 200 amperes respectively, and shall be equipped with fuses and quick-break **switches** or some approved equivalent.

Note: This requirement applies only to regular theatres where the stage is equipped for theatrical performances and not to moving-picture theatres not regularly used by theatrical companies.

- (c) Dimmers shall be so connected as to be **dead** when their respective circuit **switches** are open.

Note: Dimmers which do not open the circuit may be connected in a grounded neutral conductor.

- (d) **Portable switchboards** shall be placed within enclosures of substantial construction and may be so arranged that the enclosure is open during operation. Enclosures of wood shall be completely lined with sheet metal suitably protected from corrosion. Except as provided for dimmer faceplates, there shall be no **exposed live** parts within the enclosure.

- (e) **Portable switchboards** shall be supplied by means of **approved** stage cable terminating within the **switchboard** enclosure in an externally operable, enclosed, fused master **switch** arranged to cut off current from all apparatus within the enclosure, except the pilot light. This cable shall be of sufficient capacity to carry the total load on the **switchboard**, and the master **switch** shall not be fused above this capacity.

Portable switchboards shall be supplied only from **outlets** specially provided for the purpose.

- (f) **Conductors** within the **switchboard** enclosure shall be of the stranded asbestos-covered type enclosed in metal troughs or otherwise properly supported and securely fastened in position. **Conductors** shall have a current-carrying capacity of not less than that of the **switch** or **over-current device** to which they are connected. All **conductors** shall be bushed where they pass through metal enclosures, and strands shall be **soldered** together before being fastened under clamps or binding-screws. At terminals, **conductors** of No. 6 or larger **B. & S. Gauge**, shall be **soldered** into lugs, or connected with **approved** solderless connectors.

- (g) Stage cables shall be of **approved** type and shall be so arranged that strain is taken from clamps and binding screws. Cables shall be protected by metal bushings if they pass through metal or wood enclosures. The location, within the **switchboard** enclosure, of terminals or binding posts to which stage cables are connected, shall permit convenient access to the terminals.
- (h) **Switches** shall be of the enclosed type, externally operable.
- (i) Fuses shall be of either the plug or cartridge type and shall be provided with enclosures in addition to the **switchboard** enclosure. All circuits leaving the **switchboard** shall have an **over-current device** in each ungrounded conductor. Circuits directly supplying apparatus containing incandescent lamps shall be protected by **over-current devices** rated or set at not more than 15 amperes and other circuits shall be protected in accordance with the current required by the circuit.
- (j) The terminals of dimmers shall be provided with **approved** enclosures, and dimmer face-plates shall be so arranged that accidental contact cannot readily be made with the face-plate contacts.
- (k) A pilot light shall be provided within the enclosure, and shall be so connected to the circuit supplying the **switchboard** that the opening of the master **switch** will not cut off the supply to the lamp. This lamp shall be on an independent circuit protected by an **over-current device** rated or set at not more than 15 amperes.

Rule 3903

Footlights, Borders, Proscenium Sidelights, Strips, and Bunches

- (a) These lights, if wired in **conduit** or **armoured-cable**, shall have each **lampholder** installed in its own individual **outlet** box. If not so wired, all the **lampholders**, together with the wiring, shall be installed in a steel trough. Sheet steel used in connection with these lights, having regard to the general construction, shall be of ample strength and rigidity and the metal shall be treated to prevent rusting. Metal work for footlights, borders, and proscenium sidelights, shall be not less than No. 20 U.S. **Sheet-metal Gauge**, and for bunches and **portable** strips, shall be not less than No. 24 U.S. **Sheet-metal Gauge**. If these devices be equipped with mogul **lampholders** they shall be constructed with double walls provided with adequate ventilation between the walls.

- (b) At least $\frac{1}{2}$ in. separation shall be provided between **lamp-holder** terminals and the metal of the trough, and the **conductors** shall be **soldered** to the terminals of the **lampholders**.
- (c) For pendant devices having any lamp or group of lamps of more than 100 watts capacity, wire guards of not more than $\frac{1}{2}$ in. mesh shall be provided to prevent danger from falling glass.
- (d) **Conductors** for wiring borders shall be of slow-burning (SB) or asbestos-covered type.
- (e) Borders shall be so suspended as to be electrically and mechanically safe.
If wire rope be used, each length shall be **insulated** by at least one strain-**insulator** at the point of attachment to the border.
- (f) Borders and strips shall be so constructed that the flanges of the reflectors or other suitable guards will protect the lamps from mechanical injury and from accidental contact with scenery or other combustible material.
- (g) Cables for borders shall not be fed from side walls, but either from points on the grid-iron or from other approved overhead points.
- (h) The current in **branch-circuits** supplying footlights, border lights and proscenium sidelights shall be not more than 15 amperes. In wiring such circuits the number of **outlets** and the wattage of the lamps to be used shall be such as to meet this requirement.

Rule 3904

Stage and Gallery Pockets

- (a) Stage and gallery pockets shall be controlled from the **switchboard**.
- (b) **Conductors** supplying arc pockets shall be not smaller than No. 6 **B. & S. Gauge** and for incandescent pockets not smaller than No. 12 **B. & S. Gauge**, and shall be of ample size to supply all **receptacles** therein at full rating.
- (c) The rated capacity of arc pockets shall be not less than 35 amperes and of incandescent pockets not less than 15 amperes.
- (d) Plugs for arc and incandescent pockets shall not be interchangeable.

- (e) If wiring to pockets be in **rigid conduit** the **conduit** shall end at a point approximately 12 in. away from the pocket, and the wiring shall be continued in **flexible conduit** in the form of a loop at least 2 ft. long, thus leaving sufficient slack to permit raising or lowering of the box.

If the **rigid conduit** be embedded in concrete its end shall emerge at this point in order to leave the **flexible conduit** free for the purpose intended.

Rule 3905

Fixtures on Scenery

- (a) Fixtures shall be of the internally wired type, shall be firmly secured in place, and their stems shall be carried through to the back of the scenery with a suitable bushing on the end of the stem.

Note: See also "Installation of Fixtures and Pendant Lamps"—Rule 2010.

Rule 3906

String or Festooned Lights

- (a) Joints in wiring shall be staggered where practicable.
- (b) Lamps enclosed in devices of combustible material, such as paper lanterns or shades, shall be equipped with lamp guards.

Rule 3907

Dressing Rooms

- (a) One or more convenience **outlets**, controlled from the **switchboard**, shall be installed in each dressing-room.
- (b) All lights shall be provided with *locked* wire guards.
- (c) For pendant lights, reinforced cord, **armoured-cable**, or **armoured** flexible cord, shall be used.

Rule 3908

Portable Equipment

- (a) **Portable** equipment for stage effects shall be of a type specially **approved** for the purpose.
- (b) A qualified operator shall be employed for each arc lamp, or for each two lamps if these be so placed that one operator can properly watch and care for both.

- (c) Flexible **conductors** run from **receptacles** to arc lamps, bunches, or other **portable** equipment, shall be stage cable or Type S cord; except for the purpose of supplying miscellaneous **portable** devices under conditions where **conductors** are not exposed to severe mechanical injury, in which case reinforced cord may be used, provided that it be protected by an **over-current device** rated, or set, at not more than 15 amperes.

Rule 3909

Curtain Motors

- (a) Curtain motors shall be of the enclosed type.

Rule 3910

Stage Flues

- (a) If stage flue dampers be released by an electrical device, the circuit operating the latter shall, normally, be closed, and shall be controlled by at least two single-pole **switches** enclosed in iron boxes having self-closing doors without locks or latches, one **switch** being placed at the electrician's station and the other where required by the **Inspection Department**. The device shall be designed for the full voltage of the circuit to which it is connected, no resistance being inserted; it shall be located in the loft above the scenery and shall be enclosed in a suitable iron box having a tight, self-closing door.

Rule 3911

Motion-picture Apparatus

(For "Motion-picture Studios and Projectors" see Section 35).

- (a) **Conductors** supplying projectors shall have ample current-carrying capacity for the rating of the projector used, but shall in no case be less than No. 4 **B. & S. Gauge**.
- (b) Only reinforced cord, and **lampholders** of the keyless, moulded-composition type, provided with wire guards, shall be used in projector enclosures.
- (c) **Switches** shall be of the enclosed, externally operable type.
- (d) All projection rooms shall be provided with exhaust ventilation fans sufficient to give a complete change of air every three minutes.

A fan control **switch** must be located in the projection room, the wiring of which, and the **switch** outside the room, shall be so arranged that the fan may be controlled from either point.

The fan shall be supplied from the emergency **service**.

Note: See "Services and Service Equipment"—Section 4.

- (e) Rotating electrical machinery, commutators and other spark-emitting devices, installed in the projection booth, shall be of the totally-enclosed type.

SECTION 40—EMERGENCY LIGHTS**Rule 4001****General**

- (a) Circuits for **emergency lights** shall be used only for the supply of current to such lights.
- (b) The supply for **emergency lights** shall be taken either from a source separate from that furnishing other electric **service** in the **building**, or from a point on the supply side of the **service switch** used for other purposes of supply from the same source, and shall be provided with its own **service box**.
Note: See "Services and Service Equipment"—Section 4.
- (c) All **emergency lighting** circuits shall be controlled and protected by a single, separate, **panelboard** located in the foyer, or lobby, or other approved location in the front of the **building**. The **panelboard** shall be protected by one main **over-current device** only.
- (d) If the main source of supply be an isolated plant located in the **building**, a standby or auxiliary service of capacity sufficient to supply all **emergency lights** shall be obtained either from some outside source, or from a storage battery of adequate capacity installed upon the premises.
- (e) In auditoriums, not less than 10 watts per 100 sq. ft. of the seating accommodation shall be used for the **emergency lights**.

SECTION 41—

SMALL ISOLATED STATIONARY PLANTS

*This Section applies particularly to small isolated stationary plants driven by a prime mover, connected to an electric generator either with or without an auxiliary storage-battery with its control devices, operating at a potential of less than 50 volts. Attention shall be given to the relatively low voltage at which these plants operate; this involves more current for equivalent power and makes necessary a greater current-carrying capacity for **conductors**, fittings, devices and appliances, as compared with that required for the higher voltages used on ordinary commercial circuits.*

Rule 4101

General

- (a) These requirements shall be additional to, or amendatory of, those governing ordinary **low-potential** installations.
- (b) **Lampholders** shall be of the 660-watt, 250-volt, classification and, for the purposes of this Section, shall be rated at not more than $3\frac{1}{2}$ amperes.
- (c) No **conductor** shall have a current-carrying capacity less than that of No. 12 **B. & S. Gauge** copper wire, except that flexible cord supplying a single **lampholder** may be No. 14 **B. & S. Gauge**.

In determining the size of **conductors** required, **lampholders** shall be rated at not less than 40 watts each.

- (d) The number of **outlets** on a **branch-circuit** shall not exceed 8.
- (e) **Over-current devices**, protecting **branch-circuits**, shall be rated, or set, at not more than 20 amperes.
- (f) No current-consuming device rated at over 100 watts shall be connected to a **branch-circuit** supplying incandescent lamps. Devices of greater wattage shall be supplied from **branch-circuits** used for no other purpose, equipped with **receptacles** rated at not less than 20 amperes.
- (g) Batteries shall be located in rooms or spaces having natural means of ventilation.

SECTION 50—HIGH POTENTIAL INSTALLATIONS**Rule 5001****General**

- (a) This Section shall apply to installations operating at potentials above 750 volts.
- (b) This Section shall not be taken to apply to any equipment in connection with X-ray and high frequency installations, nor to equipment used for sign or outline lighting, radio or signalling.
- (c) The requirements of this Section shall be considered to be additional to or amendatory of the general requirements of this Code.
- (d) **Service conductors** up to 7500 volts, and all other **conductors** operating at more than 7500 volts between **conductors**, shall, if within **buildings**, be installed only in such occupancies as central stations; sub-stations; **electrical equipment** vaults; or in **fire-resisting** motor or generator rooms; or by **special permission** in **fire-resisting buildings**. (See Rule 5002 (1)).

Rule 5002**Conductors**

(See Rule 501).

- (a) Wiring may be either single or multiple **conductor** and except as permitted in Clauses (b), (c) and (d) below, shall be sheathed with a lead or other approved **absorption-resisting** covering and shall be either **armoured** or installed in **rigid conduit** or **flexible conduit** or duct.

Where single-**conductor** cables are completely encircled by magnetic material all cables shall be grouped within the same enclosure.

Approved terminal facilities shall be provided to protect cables from hazards due to moisture.

- (b) For line potentials not exceeding 5000 volts, **conductors** having **approved insulation** without **absorption-resisting** metallic sheathing, may be installed in **rigid** and **flexible conduit** in normally dry locations where there is no risk of flooding.
- (c) **Insulated** cables **approved** for the voltage involved, and without a conducting sheath, may, by **special permission**, be employed in central stations, sub-stations, **fireproof** generator and motor rooms, and transformer vaults, up to 5000 volts between phases, without limitation as to clearances.

- (d) Bare **conductors** may by **special permission** be employed in central stations, sub-stations, generator and motor rooms, and transformer and electrical equipment vaults.
- (e) **Conductors** shall be mounted on approved supports at intervals not exceeding $4\frac{1}{2}$ ft., and bare **conductors** shall be spaced as follows:

TABLE XXXIV
MINIMUM SPACINGS FOR BARE HIGH-POTENTIAL
CONDUCTORS

Voltage	Minimum Distance between Live Parts	Minimum Distances from Live Parts to Adjacent Surfaces exclusive of Conductor Supports
	Inches	Inches
751— 2,500	6	3
2,501— 7,500	8	6
7,501—15,000	12	9

- (f) Where a cable issues from its lead sheath, the **insulation** of the **conductors** shall be thoroughly protected from moisture and mechanical injury by a pothead or equivalent device.
- (g) In normally dry locations, if splices or taps be required between lengths of rubber-covered lead-sheathed cable, the lead sheath need not be continuous over such splices or taps. The ends of the sheaths shall be belled out and bonded together around the splice by copper wire having a current-carrying capacity not less than that of the sheath, and **ground** clamps and in no case less than No. 6 **B. & S. Gauge**. Splices shall be thoroughly **insulated**.
- (h) Lead-covering, metal armour, **conduit**, and fittings shall be thoroughly bonded together and **grounded**.
- (i) **Electrical equipment** shall be **inaccessible** to **unauthorized persons**.

A permanent warning notice shall be placed in a conspicuous position forbidding anyone to work on any **live** equipment unless protected by **approved insulated** or **insulating** appliances, such as tongs, rubber gloves, boots, mats, etc. Such appliances shall always be maintained in proper condition for use.

- (j) **High-potential conductors** shall not be installed in **elevator hoistways**, but may be installed in **conduit** embedded in the masonry walls of **hoistways**. (See Rule 5002 (l)).
- (k) **Service conductors**, except as provided in the next succeeding paragraph, shall be single or multiple-**conductor** lead-covered cable. If not underground they shall either be armoured or run in **conduit**. If underground, an approved duct may be used.
- Overhead **service conductors** may, by **special permission**, be carried into **buildings** through **approved** leading-in devices or in some other approved manner. Such **conductors** shall be so located or **guarded** as to be **inaccessible** from the ground and from any window, balcony or similar point.
- Conductors** used for **services** shall be not smaller than No. 6 **B. & S. Gauge** unless they are lead-covered. If lead-covered, **conductors** shall be not smaller than No. 8 **B. & S. Gauge**.
- (l) **Service** and other **conductors** which are installed in **conduit** or ducts run beneath a **building** or within a wall of concrete or brick shall be considered as being outside the **building** when the **conduit** or duct is surrounded throughout its run by not less than 2 in. of concrete or brick.
- (m) In the case of one or more transformers supplying only **buildings** under the same ownership the primary **conductors** may be considered as **service conductors** if the current-carrying capacity of the secondary **conductors** be greater than that of the largest **approved service box**. Under the foregoing conditions the **high-potential service** equipment shall be accessible only to **authorized persons**, but the **service circuit-breaker** shall be operable by the consumer and from within the **building** served.
- Note: These requirements may be satisfied either by a remote control **circuit-breaker** or by some suitable means which will trip the **circuit-breaker** from within the **building** served.*
- (n) Closely grouped open **conductors** with **insulating** coverings subject to arcs or heat due to short-circuits in nearby **conductors**, shall have a **flame-retarding** outer covering. The coverings of such **conductors** shall be stripped back from terminals a sufficient distance to prevent leakage.

Rule 5003**Control and Overcurrent Protection**

- *(a) Every **service** shall be equipped with an oil-immersed **circuit-breaker** which shall be installed as close as possible to the **service** entrance and arranged to control all **ungrounded conductors** of the **service**. The **circuit-breaker** shall have a rupturing capacity approved by the **Supply Authority**, and shall be fitted with protective devices in accordance with Table XX, Rule 803, which shall be adjusted to the satisfaction of the **Supply Authority** and of the **Inspection Department**; they shall be of the trip-free type and shall incorporate a device indicating whether they are open or closed. Fuses in conjunction with a non-automatic oil **switch**, may be used where the conditions outlined in Rule 5003 (h) are complied with.

Provided that when the total load on the **service** consists solely of transformers and the **service** equipment is installed in a vault, the **service circuit-breaker** may be omitted when either of the alternatives permitted by Subclauses 1 and 2 hereof are provided.

- (1) If the primary voltage does not exceed 25,000 volts and the total load does not exceed 200 k.v.a. per phase, a non-automatic oil switch and suitable fuses may be installed.
 - (2) If the primary voltage does not exceed 5,000 volts and the total load does not exceed 100 kva. per phase, suitable fuses may be installed.
- *(b) At **service** entrances **isolating switches** shall be provided on the supply side of the **circuit-breaker** as close as possible to the **service** entrance.

Isolating switches of air-break type shall be installed on each primary **service conductor** ahead of **circuit-breakers** or **switches**, except in cases where the **service** control consists of enclosed removable truck panels or metal-clad switch-gear units so arranged that when they are removed from their normal position the **circuit-breaker** or **switch** will be automatically disconnected from all **live-parts**.

Where the **fuses** permitted by Sub-clauses 1 and 2 of Clause 5003(a) are of a type which may be operated as an **isolating switch**, they may serve as **isolating switches** if they completely disconnect all other **service** equipment from the source of supply.

*(See editor's note on page 173).

If the **service** be not over 5,000 volts and be installed in a transformer vault under the sole control of the **Supply Authority**, the requirements for **isolating switches** may by **special permission** be fulfilled by means of a disconnecting pot-head.

**(Editor's Note: Further revision of Rules 5003 (a) and (b) is under consideration due to strong requests for modifications by the representative of the Canadian Electrical Association, as sufficient time for modifications was not available prior to going to press.)*

- (c) Oil **circuit-breakers** for voltages above 5000 volts shall be isolated from other apparatus when practicable, and be outside the vaults containing the transformers they are used to control. Where series trip-coils are used they shall be suitably **guarded**. Oil **circuit-breakers**, if mounted in a closed compartment shall be provided with means to indicate whether the **breaker** is open or closed. They shall comply with one of the following:
 - (1) They shall be mounted, remote from the control panel in a **fireproof switch** room, motor room, or in a vault complying with Rule 5004; oil **circuit-breakers** above 15,000 volts shall be installed only in a vault complying with Rule 5004, or:
 - (2) They shall be of metal-enclosed type such as metal-clad **switch** gear, trucks, cubicles, and **switch** houses.
- (d) At locations other than those at the **service** entrance, **isolating switches** shall be installed ahead of **circuit-breakers** or **switches** except in cases where the control consists of enclosed removable truck panels or metal-clad **switch** gear units so arranged that when they are removed from their normal position the **circuit-breaker** or **switch** will be automatically disconnected from all **live** parts.
- (e) Barriers shall be provided on each side of each pole of **isolating switches** wherever used, unless they are so "interlocked" that they cannot be operated under load: notices warning against wrongful operation shall be installed nearby.
- (f) **Isolating switches**, of air-break type, whether located at a **service-entrance** point or elsewhere, shall be accessible to **qualified persons** only.

- (g) Each transformer or bank of transformers operating as a unit, except instrument transformers, and each other operating unit of apparatus and each **conductor of branch circuits** shall be **protected** from over-current by a manually-operable **circuit-breaker** which will interrupt all **ungrounded conductors**, except as provided in Clause 5003(h). Potential instrument-transformers shall be **protected** in the primary circuit by a **fuse** rated at not more than 3 amperes.

*Note: It is recommended that external resistors be connected in series with the primary windings of **potential** instrument-transformers of **high-potential** rating, in order to limit the possible short-circuit current to a value which can safely be interrupted by the **fuse**.*

- (h) Oil-filled or other suitable types of **fuses** may be used on circuits not exceeding 2500 volts to ground and rated at not more than 300 amperes or not exceeding 15,000 volts between phases and 100 amperes, for the following purposes:
- (1) For the protection of individual **feeder** or **branch-circuits** at the point where they receive their supply. If there be more than one such circuit, there shall be a manually operable **circuit-breaker** between the point of origin of such circuits and the source of supply.
 - (2) For the protection of individual transformers, or banks of transformers operating as a unit when such transformers are supplied by a common **feeder**, provided that such **feeder**, at the point where it receives its supply, be protected by a manually operable or remote control **circuit-breaker**. The circuit supplying a single transformer or bank of transformers need not have **circuit-breaker** protection.
 - (3) For the protection of other classes of apparatus by **special permission**.
- (i) Fusible cutouts shall be so installed that the blowing of the **fuse** will not result in injury to persons or damage to other equipment. They shall be **accessible to qualified persons only**.
- (j) Where oil-immersed **isolating switches** are used, they shall be mechanically, or electrically, interlocked with the **circuit-breaker**, or **circuit-breakers**, so that it will not be possible to open or close the **isolating switch** unless the **circuit-breaker**, or **circuit-breakers**, be open. Oil-immersed **isolating switches** shall be provided with a position indicator operating from the contact bars or, alternatively, with inspection ports, such that the position of contacts can be seen.

Rule 5004

Vaults for High-potential Installations

- (a) The walls and roof of vaults shall consist of reinforced concrete not less than 6 in. in thickness or of brick not less than 8 in. or of load-bearing hollow tile not less than 12 in. in thickness coated on the inside with cement plaster; except that if the total transformer capacity so enclosed be not more than 100 k.v.a., reinforced concrete 4 in. thick may be employed by **special permission**. Where practicable, the outside walls of the **building**, if of standard vault construction, should form one of the walls of the vault.

No material or equipment of any kind, including air ducts, gas lines, water, steam or solvent line, shall pass through or terminate within a vault, other than that essential to the transformer installation or to its proper operation and safety.

- (b) Vaults shall be thoroughly ventilated by a chimney or flue, leading out of doors, of such size as will prevent the development of room temperatures in excess of those at which the transformers installed therein may be safely operated. Limiting temperatures shall be determined in accordance with the requirements of **Supply Authorities** and **Inspection Departments**. All ventilating openings not connected to chimneys or flues shall be provided with automatic or manually controlled dampers.

Inlet for fresh air shall be provided by a flue or iron pipe leading from the outside air, where feasible, and terminating in the compartment at a point not more than 3 ft. above floor level. When ventilated from within the building, openings shall have heat-actuated automatic dampers.

Note: It is recommended that damper control be arranged to be operated from a point outside the vault.

- (c) Suitable means of draining the vault shall be provided in order that any accumulation of oil or water may be conveniently carried off. Floor and drain shall have a slope of not less than $\frac{1}{4}$ in per ft. From vaults containing transformers having a total capacity of 100 kva. or less, the drain may be omitted if the enclosure be so constructed as to retain all the oil, in the event of leakage from the transformer, within the vault.

- (d) Unless access be from outside the **building** only, the doorway to the vault shall be thoroughly closed by means of a tight-fitting **approved fire-door** (Class "A" door and hardware—Underwriters Laboratories Inc.) A door sill not less than 4 in. in height shall be provided. In all cases the sill shall be of sufficient height to confine within the vault the oil from the largest transformer installed therein.
- (e) The vault shall be provided with an adequate lighting system controlled by a **switch** suitably located near the entrance to the vault, preferably outside.
- (f) The door of the vault shall be provided with a substantial lock, so that only **authorized persons** will have access to the vault.
- (g) Transformers supplying electric furnaces in electric furnace rooms of **fireproof** construction may be installed without a vault if provided with a concrete basin having curbs not less than 6 in. in height on the inside surface and of dimensions sufficient to retain all the oil used in the transformers. There shall be no other combustible material in the vicinity of such transformers.

SECTION 51—X-RAY AND HIGH-FREQUENCY INSTALLATIONS

Note: The requirements of this Section shall be in addition to, or amendatory of, those prescribed in Sections 1 to 20, inclusive, of this Code.

Rule 5101

High-voltage Guarding

- (a) Mechanical barriers to prevent too close approach to any high-voltage parts of X-ray apparatus, except the X-ray tube and its leads, shall be provided unless such high-voltage parts be rendered **shock-proof** by being shielded by **grounded** metal or approved insulating material. High-voltage generators operating at 300 peak kv. or more shall be installed in rooms separate from those containing the other equipment. A suitable **switch** shall be provided to control the circuit supplying the generator, and it shall be so arranged that it will necessarily be open except while the door of the room is locked from the outside. X-ray tubes in therapy shall be mounted in a **grounded** metal enclosure.

Note: Shock-proof: As applied to X-ray and high-frequency equipment, means that the equipment is guarded with grounded metal so that no person can come into contact with any live part.

The second sentence of the Clause does not apply to shock-proof portable units, or to shock-proof self-contained, stationary units.

- (b) Every X-ray machine shall be provided with a milliammeter or other suitable measuring instrument. This instrument shall be readily visible from the control position and shall be connected, if practicable, in the **grounded** lead and shall be **guarded** if it be connected in the high-voltage lead.
- (c) All X-ray apparatus for industrial use shall be of the **shock-proof** type.

Rule 5102

Wiring etc.

- (a) For non-**shock-proof** equipment overhead high-voltage **conductors** unless suitably **guarded** from personal contact shall be spaced according to Table XXXV. The high-voltage leads on tilting tables and fluoroscopes shall be adequately **insulated** or so surrounded by barriers that inadvertent contact with them will be improbable.

TABLE XXXV
MINIMUM SPACINGS FOR HIGH-VOLTAGE CONDUCTORS

Voltage Peak KV.	Opposite Polarity Inches	To Ground Inches	Above the Floor Feet
100	12	8	8
200	24	12	10
300	36	24	10
400	48	36	10

- (b) The low-voltage circuit of the step-up transformer shall contain a manually-operable control device having overload protection, in addition to the **over-current device** for circuit protection. These devices shall have no **exposed live** parts. For diagnostic work there shall be an additional **switch** on this circuit, which shall be of one of the following types:
- (1) A **switch** with a spring or other mechanism that will open automatically except while held closed by the operator.
 - (2) A time-**switch** which will open automatically after a definite period of time for which it has been set.
- (c) If more than one piece of apparatus be operated from the same high-voltage source, each shall be provided with a high-voltage **switch** to give independent control.
- (d) Low-frequency current-carrying parts of machines of the quenched-gap or open-gap type shall be so **insulated** or **guarded** that they cannot be touched during operation. This applies to all parts except the high-frequency circuit proper which delivers high-frequency current normally for therapeutic purposes.
- (e) Transformers which are part of an X-ray or high-frequency apparatus, even though they contain oil, shall be considered and treated as a part of the device, and need not conform to the requirements of Rule 2003 for power transformers.
- (f) All X-ray generators having capacitors shall have suitable manual means for discharging the capacitors.
- (g) Except in the case of self-contained units all 200 peak kv., or higher, X-ray generators shall have a sphere-gap installed in the high-voltage system, adjusted so that it will break down on over-voltage surges.

Rule 5103

Grounding

- (a) All non-current-carrying metal parts of tube stands, fluoroscopes, and other apparatus shall be **grounded** in conformity with the requirements of Section 9. **Insulating** floors, mats or platforms shall be provided for operators in proximity to high-voltage parts unless such parts be rendered **shock-proof**.

*Note: It is recommended that floors of concrete or other conducting material be completely covered with approved **insulating** material, lapped at the joints and secured in place without the use of metal. It is also recommended that non-metallic tables and chairs be used.*

- (b) Where short-wave therapy machines are used, the treatment tables and examining chairs shall be wholly non-metallic.

*Note: The presence of any metal in the high-frequency field is a definite fire hazard owing to the high temperature generated by eddy current losses set up in the metal. The use of **insulating** floor coverings is recommended where non **shock-proof** X-ray equipment is used.*

SECTION 52—HIGH-POTENTIAL LUMINOUS-DISCHARGE-TUBE INSTALLATIONS

Rule 5201

Wiring and Equipment

(See also “Signs and Outline Lighting”—Section 38).

Note: Luminous-discharge-tubes are usually, for convenience, called “gas-tubes”.

- (a) Gas-tubes shall be substantially supported and shall not be in dangerous proximity to either **flammable** or **grounded** material.
- (b) The tube terminals shall be isolated from combustible material and shall be rendered **inaccessible** to **unauthorized persons** either by being within the enclosure of a sign, or within a separate **approved** enclosure consisting either of **incombustible, absorption-resisting, insulating** material or of sheet metal not less than No. 24 **U.S. Sheet-metal Gauge**. Such metal, if subject to corrosion, shall be galvanized, treated with at least three coats of anti-corrosive paint, or otherwise suitably protected.
- (c) Connections at electrodes shall be mechanically and electrically secure, and shall be **soldered**, unless solderless connectors are used.
- (d) Transformers and other **electrical equipment** operating at **high potential**, unless of weather-proof type shall be installed in approved cabinets unless they be placed within the metal enclosure for the complete assembly.
- (e) The open-circuit secondary voltage of transformers shall not exceed 15,000 volts.
- (f) **High-potential conductors** shall be suitably supported on insulators. If **conductors** be within reach they shall either be lead-covered **approved** for this purpose or installed in metal troughing.
- (g) Each transformer shall be protected by an **over-current device**. More than one transformer may be dependent on one **over-current device** if the combined load does not exceed 1,650 volt-amperes. If additional devices for the

individual protection and disconnection of transformers in signs be used, they may be placed either inside or outside the sign structure; if exposed to the weather they shall be of weather-proof type.

- (h) Enclosures for transformers and regulating coils shall be well ventilated and so designed as to prevent the emission of flames or sparks in case of burn-out.
- (i) Enclosures for transformers, regulating coils, and tube terminals, having, within the enclosure, any **exposed live** parts, shall be so arranged that the door of the enclosure cannot be opened while the primary circuit is closed.
- (j) For bonding together isolated tube terminal boxes on any one outline system, copper wire of not less than No. 14 **B. & S. Gauge** shall be used.

SECTION 60—ELECTRICAL COMMUNICATION SYSTEMS

Rule 6001

Classification of Communication Circuits

For the purpose of this Section communication circuits are classified as follows:—

CLASS 1—Circuits which are connected to power sources in such a manner that the current, voltage, and wattage of the circuit are not limited as in Class 2 circuits. Class 1 circuits are deemed to be power circuits to be constructed in accordance with the appropriate requirements of Sections 1 to 20 and subject to approval by the **Inspection Department**.

CLASS 2—Systems in which the power is limited as in (1) or (2) below. Class 2 circuits, when installed in compliance with the provisions of Rules 6002 to 6004 are not subject to approval by the **Inspection Department**, except that in the case of communication circuits which derive power for operation from supply circuits, the transformer or other current-limiting device used at the junction with the supply circuit is subject to such approval.

- (1) Circuits operated as part of a central-station or central-exchange **communication system** such as telephone, telegraph, district messenger and the like.

- (2) Local **circuits** (which may, or may not, extend beyond one **building**) for signalling, which meet any one of the requirements of the following Table:—

TABLE XXXVI
Protection for Local Communication Circuits.

Operating Voltage	Required Protection
Not more than 15	5 ampere fuse or transformer having inherent current-limiting characteristics and approved for the purpose, or other current-limiting device. Exception:—Where the source of power is primary batteries no protection is required.
More than 15 but not exceeding 30	3 ampere fuse or alternative as above. Exception:—Where the source of power is primary batteries no protection is required.
More than 30 but not exceeding 60	2 ampere fuse or alternative as above.
More than 60	1 ampere fuse and an approved transformer having inherent current-limiting characteristics and approved for the purpose or other current limiting device so designed that the maximum power input will not exceed 150 watts with short-circuit on the output terminals.

Rule 6002
In Buildings
General

- (a) **Conductors** on the consumer's or subscriber's side of the protector and **conductors** inside **buildings** where no protector is provided, shall be neatly arranged and secured in place in a convenient and workmanlike manner. They shall not approach nearer than 2 in. to any electric light or

power **conductor** unless one **system** is in **conduit** or the two **systems** are permanently separated by a continuous and firmly-fixed non-conductor additional to the **insulation** on the **conductors**.

Note: See "Surface-raceway Work" — Rule 508 (f) and "Underfloor Raceways"—Rule 511(j).

*The **conductors** would ordinarily be **insulated** but the kind of **insulation** is not specified as reliance is placed on the protector to stop all dangerous currents. Porcelain tubes and **flexible tubing** are considered suitable non-conductors.*

- (b) **Conductors** bunched together in a vertical run shall have a flame-retarding covering sufficient to prevent the carrying of fire from floor to floor. This requirement need not apply if the **conductors** be encased in **incombustible** tubing or be located in a **fireproof** shaft having fire-stops at each floor.
- (c) Signal **conductors** shall not be placed in any **outlet** box, junction box or similar fitting or compartment containing electric light or power **conductors** unless they are separated from them by a suitable partition, except where the power **conductors** are introduced solely for power supply for signalling equipment or for connection to remote-control equipment.
- (d) Transformers and other devices supplying current to signal systems from electric light or power circuits shall be of a type expressly **approved** for such service; the secondary wiring shall conform to the requirements of this Section and the primary or charging circuit wiring to the requirements of Sections 1 to 20.

Rule 6003

Protection

Where the Outside Wiring of a Communication System consists of Aerial Conductors.

- (a) In general, an **approved** protector shall be placed within the **building** as near as practicable to the point of entrance, but not in the immediate vicinity of **flammable** or explosive materials and shall be mounted on an **incombustible, absorption-resisting, insulating** base.

*Notes: (1) If desired, the protector may be placed in a weather-proof box installed on the outside of the **building** wall immediately adjacent to the point of entrance.*

*(2) Where a number of **conductors** are grouped to serve a **building** the protectors may be mounted on a **grounded** metallic frame.*

(3) In the case of an underground entrance, the protector may be located at the junction of the underground and aerial wires.

- (b) The protector shall consist of a lightning-arrester between each line-conductor and **ground** and a fuse in each line **conductor**, the fuses protecting the arresters. The protector terminals shall be plainly marked to indicate "line", "instrument" and "**ground**".
- (c) If the entire street circuit be run underground, no protector need be provided unless that portion of the circuit between the street and the **building** be liable to accidental contact with electric lighting or power **conductors**, operating at a potential exceeding 250 volts.

Rule 6004

Grounding

- (a) **Grounding conductors** for the protection of Class (2) **communication systems** shall be of copper not less than No. 18 B. & S. Gauge and shall be **insulated** with rubber not less than 1/32 in. thick, covered with a substantial braid. Such **grounding conductors** shall be run in as straight a line as possible, and shall preferably be connected to a water-pipe **ground**. In the absence of a water-pipe **ground**, connection may be made to a **grounded** metallic structure, or to a driven **ground**.
- (b) No **grounding conductor** and no artificial **ground** used for **grounding** any other type of electrical system shall be used for the **grounding** of a Class 2 **communication system**, except when the grounding conductors of both systems are connected with a low resistance ground, such as a neutral grounding system or a public water-piping system.
- (c) The **grounding conductor** shall be attached to the pipe by means of an **approved** bolted clamp to which the **conductor** is **soldered** or otherwise connected in a suitable manner.

Rule 6005

Outside Conductors

Note: These regulations are temporarily included in Part I of the Code until Part III of the Code is completed.

- (a) **Special permission** shall be obtained if it be desired either to attach **conductors** to the upper surfaces of roofs or to run them over roofs with a clearance of less than 6 feet except in the case of auxiliary **buildings** of one storey such as **garages** and the like.
- (b) Underground **conductors** shall not be placed in any duct or lateral containing electric lighting or power **conductors** nor shall the latter be placed in any communication duct or lateral.

If manholes be used jointly by electric lighting or power cables and those of **communication system**, the two classes shall be separated as widely as possible and shall, where practicable, enter and leave the manholes at opposite sides.

Note: It is strongly recommended that the communication and supply cables be separated throughout their length by adequate thicknesses of either brick, concrete, tile or similar materials, and that communication cables in manholes be encased in Portland cement one-half inch in thickness; all other cables to be protected in the same manner or by means of webbed asbestos.

- (c) Overhead **conductors** shall not be attached to a crossarm carrying electric lighting or power **conductors** nor shall they, when on the exterior walls of buildings, be brought closer than 4 in. to electric lighting or power **conductors** unless one **system** be in **conduit** or be permanently separated from other **systems** by a continuous, firmly-fixed non-conductor additional to the **insulation** on the **conductors**.
- (d) Metal sheaths of aerial cables which are liable to contact with electric lighting or power **conductors**, shall either be interrupted, close to the entrance to a **building**, by an **insulating** joint or some approved equivalent, or shall be **grounded**.

- (e) On any pole carrying **conductors** of both **communication** and electric lighting or power **systems**, the distance between the two inside pins on any crossarm shall be not less than 30 in., except on a pole carrying **conductors** of one of the two systems for clearance purposes only, when crossing the other system's pole lines. Wherever practicable, the **conductors** of the **communication systems** shall be supported on the lower cross-arms.
- (f) Aerial cables of the metal-sheathed type shall have paper or other suitable **insulation**. If the metal sheath be omitted, and the **conductors** are bunched, each **conductor** shall be **insulated** with rubber not less than 1/32 in. thick, and the whole shall be covered with a substantial braid.
- (g) **Conductors** from the last outdoor support to the protector, and **conductors** attached to **buildings**, shall have rubber **insulation**, not less than 1/32 in. thick on each wire; in addition, the **conductors**, either individually or bunched, shall be covered with a substantial braid. If not run in **conduit** such **conductors** where attached to **buildings**, shall be separated from woodwork by being supported on glass, porcelain, or other **insulating** material suitable for the purpose.
- (h) **Conductors** shall enter **buildings** either through **incombustible, absorption-resisting, insulating** bushings or through **rigid conduit**, or **armoured-cable** shall be used. If bushings be used these shall slope upward from the outside, or if this cannot be done, drip-loops shall be formed in the **conductors**, immediately outside the point of entrance. **Conduit** shall be equipped with weather-proof **service-fittings**. More than one **conductor** may enter through one bushing or **conduit**.
- (i) The preceding Clauses (g) and (h) shall not apply if the **conductors** enter a **building** in the form of a cable such as is described in Clause (f) nor if the entire street circuit be run underground, and that portion of the circuit between a street and a **building** be not liable to accidental contact with electric lighting or power **conductors** of over 250 volts.

SECTION 70—MAINTENANCE AND OPERATION

Note: See Appendix A—Instructions for Resuscitation from Electric Shock.

Rule 7001

General

- (a) All operating **electrical equipment** shall be kept in safe and proper working condition. Defective equipment shall either be put in good order or permanently disconnected.
- (b) Infrequently used **electrical equipment** maintained for future service shall be thoroughly inspected before use in order to determine its fitness for service.

Electrical equipment maintained for emergency service shall be periodically inspected and tested as may be necessary to determine its fitness for service.

- (c) Adequate precautions shall be taken to prevent any **electrical equipment** from being electrically charged, either accidentally or inadvertently, when work is being done thereon.

*Note: Warning notices; locks on **switches**; sentries; or other equally effective means should be employed.*

- (d) No repairs or alterations shall be carried out on any **live** equipment except where complete disconnection of the equipment is not practicable. In places where explosive or highly **flammable** materials or gases are present, repair or alteration shall not be made on any **live** equipment.

*Note: For the purpose of this rule, outlets controlled by 3-way or 4-way **switches** do not disconnect the circuit.*

- (e) If potentials exceeding 750 volts be employed, a permanent warning notice shall be placed in a conspicuous place forbidding any one to work on any **live** equipment unless protected by approved **insulated** or **insulating** appliances, such as tongs, rubber gloves, boots, mats, etc. Such appliances shall always be maintained in proper condition for use.
- (f) Passageways around such machinery and equipment as generators, transformers and **switchboards** shall be kept clear of any obstruction and so arranged as to give **authorized persons** ready access to all parts requiring attention.
- (g) Adequate illumination shall be provided.
- (h) **Flammable** material shall not be stored or placed in dangerous proximity to **electrical equipment**.

APPENDICES

APPENDIX A

RESUSCITATION

from

ELECTRICAL SHOCK

by the

PRONE PRESSURE METHOD

Revision of 1927

*(Printed verbatim from copy furnished by
Mr. Wills Maclachlan, Toronto)*

*Approved and recommended by
Canadian Engineering Standards Association*

Canadian Electrical Association

Electrical Employers Association of Ontario

*Hydro-Electric Power Commission of Ontario
and a considerable number of organizations and
governmental departments in the United States*

In order that employees be familiar with resuscitation, it is necessary to give frequent practical instruction and demonstrations in the use of these rules and to require superintendents, foremen or others having charge of men, to be responsible for the regular practice of the method by all employees. It is further recommended that, wherever possible, these practice meetings be held monthly and that a record be kept of the attendance.

The Prone Pressure Method of Artificial Respiration is equally applicable to all cases of suspended respiration, whether due to electrical shock, drowning, inhalation of gas, smoke, fumes or other causes.

INSTRUCTIONS FOR RESUSCITATION

Follow these instructions even if the victim appears dead.

I—Free the Victim from the Circuit Immediately.

1.—Quickly release victim from current, being careful to avoid receiving a shock. Use any dry non-conductor (rubber gloves, clothing, wood, rope, etc.) to remove either victim or conductor. Beware of using metal or any moist material. If necessary shut off current.

2.—As soon as victim is clear of conductor rapidly feel with your finger in his mouth and throat and remove any foreign body (tobacco, false teeth, etc.) If mouth is tight shut, pay no more attention to it until later. Do not stop to loosen patient's clothing, but immediately begin actual resuscitation. Every moment of delay is serious. Proceed as follows:

STANDARD TECHNIQUE

II.—Instantly attend to victim's breathing.

1.—Lay the patient on his belly, one arm extended directly overhead, the other arm bent at elbow and with the face turned outward and resting on hand and forearm, so that the nose and mouth are free for breathing. (See Fig. 1.)

2.—Kneel straddling the patient's thighs with your knees placed at such a distance from the hip bones as will allow you to assume the position shown in Fig. 1.

Place the palms of the hands on the small of the back with fingers resting on the ribs, the little finger just touching the lowest rib, with the thumb and fingers in a natural position, and the tips of the fingers just out of sight. (See Fig. 1.)

3.—With arms held straight, swing forward slowly so that the weight of your body is gradually brought to bear upon the patient. The shoulder should be directly over the heel of the hand at the end of the forward swing. (See Fig. 2.) Do not bend your elbows. This operation should take about two seconds.

4.—Now immediately swing backward so as to completely remove the pressure. (See Fig. 3.)



FIGURE 1

(Illustrations by courtesy of Mr. Wills MacLachlan)

FIG. 1. Position in which patient should always be placed and kept until conscious, also first position for operator starting artificial respiration.



FIGURE 2

FIG. 2.—Second position of operator giving artificial respiration.

5.—After two seconds swing forward again. Thus repeat deliberately twelve to fifteen times a minute the double movement of compression and release, a complete respiration in four or five seconds.

6.—Continue artificial respiration without interruption until natural breathing is restored, if necessary, four hours or longer, or until a physician declares the patient is dead.

7.—As soon as this artificial respiration has been started and while it is being continued, an assistant should loosen any tight clothing about the patient's neck, chest or waist. **KEEP THE PATIENT WARM.** Do not give any liquids whatever by mouth until the patient is fully conscious.

8.—To avoid strain on the heart when the patient revives, he should be kept lying down and not allowed to stand or sit up. If the doctor has not arrived by the time the patient has revived, he should be given some stimulant, such as one teaspoonful of aromatic spirits of ammonia in a small glass of water or a hot drink of coffee or tea, etc. The patient should be kept warm.

9.—Resuscitation should be carried on at the nearest possible point to where the patient received his injuries. He should not be moved from this point until he is breathing normally of his own volition, and then moved only in a lying position. Should it be necessary, due to extreme weather conditions, etc., to move the patient before he is breathing normally, resuscitation should be carried on during the time that he is being moved.

10.—A brief return of natural respiration is not a certain indication for stopping the resuscitation. Not infrequently the patient after a temporary recovery of respiration, stops breathing again. The patient must be watched and if natural breathing stops, artificial respiration should be resumed at once.

11.—In carrying out resuscitation, it may be necessary to change the operator. This change must be made without losing the rhythm of respiration. By this procedure no confusion results at the time of change of operator and a regular rhythm is kept up.



FIGURE 3

FIG. 3.—Third position of operator giving artificial respiration.

III.—Send for Doctor

If alone with victim, do not neglect immediate and continued resuscitation in order to call a doctor. Start at once—the first few minutes are valuable. If other persons are present, send one of them for a doctor without a moment's delay.

The ordinary and general tests for death should not be accepted and any doctor should make several very careful and final examinations and be sure specific evidence is present before pronouncing the patient dead.

In view of the careful study and extensive experiments carried out under Professor MacLeod's direction, a statement from him is extremely important.

Paralysis of the nerve centre which controls breathing is the cause of death in many cases of electrocution and, provided the heart has not been directly affected by the current, natural breathing can often be restored by artificial respiration. This allows the still circulating blood to be aerated in the lungs. The only method to employ is Schafer's Prone Pressure Method and a pulmotor or any other form of apparatus should never be used. Since the paralysis of the breathing may last for some time it is necessary to continue artificial respiration sometimes for hours and it should never be discontinued until it is absolutely certain that the heart has ceased beating. As far as can be judged by observations on electrocuted animals, no advantage is gained by using oxygen or carbon dioxide during the artificial respiration, or by administering heart stimulants. It is important to see that the body is kept warm. After natural breathing returns the patient must be kept lying down and he must be carefully watched for several hours to see that the paralysis of breathing does not return. If it does so, artificial respiration must be reapplied.

J. J. R. MACLEOD,

*Professor of Physiology,
University of Toronto.*

APPENDIX B

COMMITTEE ON CANADIAN ELECTRICAL CODE

PART I

(Inside Wiring Rules)

ORGANIZATION AND RULES OF PROCEDURE

1.—General.

The preparation and revision of the Canadian Electrical Code, Part I, shall be executed by the following Committees working in conformity with the procedure hereinafter set forth in Clause 4:

The **Committee on C. E. Code, Part I** (referred to in this Appendix as the "**C. E. Code Committee**"),

The **Central Committee**,

Nine **Provincial Committees**—one in each province.

2.—Authorization

Based on recommendations emanating from a conference of Canadian Electrical Code interests, held in June, 1938, the C.E.S.A. Executive Committee, on November 25th, 1938, authorized the reorganization of the C. E. Code Committee and Provincial Committees, and the organization of a Central Committee, according to the constitution outlined hereinafter in Clause 3.

3.—Organization

The members of the Committees, referred to in Clause 1, may be nominated by the various organizations designated below, such nominations being subject to the approval of the Executive Committee of the Canadian Engineering Standards Association. Should any organization fail to nominate its representative to any of the Committees, as provided, within a reasonable time after having been requested to do so, the Executive Committee may appoint such representative. The Executive Committee may also appoint members to these Committees.

- A. **Committee on C. E. Code, Part I** ("**C. E. Code Committee**)—The C. E. Code Committee shall be composed of a Chairman appointed by the Executive Committee

of the Canadian Engineering Standards Association, and 26 members, and shall be constituted as follows:

Chairman..... 1

Inspection Group—

(a) Provincial Electrical Inspection Authorities
or other Provincial representatives..... 9
(b) Municipal Inspection Authorities..... 2
(c) Fire Underwriters' Associations..... 2
(d) Provincial Fire Marshals..... 1

Electrical Manufacturers—

(Canadian Manufacturers' Assn.)..... 2

Electrical Utilities—

(a) Publicly-owned..... 1
(b) Privately-owned (Canadian Electrical Assn). 1

Miscellaneous—

(a) Railways..... 2
(b) Labour..... 1
(c) Communication Interests (Telephone (Assn.
of Canada)..... 1
(d) Professional Societies..... 1
(e) Dominion Government..... 1
(f) Canadian Transit Association..... 1
(g) National Research Council..... 1

Total..... 27

B. **Central Committee**—shall be composed of eleven members who may be nominated by the C. E. Code Committee and appointed by the Executive Committee, and shall execute the details of work relative to general revision, interim revision, interpretation and editing of the Canadian Electrical Code, Part I.

C. **Provincial Committees**—Each Provincial Committee shall consist of not more than seven voting members, nominated by the Chief Officer of the Electrical Inspection Authority in the Province, who shall be Chairman. Such nominations shall be approved by the Executive Committee. The Chairmen of Provincial Committees may add non-voting members to their Committees.

If in any Province there is no Provincial Electrical Inspection Authority, the Executive Committee may appoint the Chairman of the Provincial Committee.

4.—General Revision—Canadian Electrical Code

Part I

Procedure to be followed in the revising of the Canadian Electrical Code, Part I:—

October 1st*—

- (a) **C.E.S.A. Secretary**—Submission of revision proposals shall be made to the C. E. S. A. Secretary on or before October 1st, by Provincial Committees or the public, for submission to the Central Committee.

April 1st—

- (b) **Central Committee—Discussions of Recommended Revisions**—Consideration of proposals by Central Committee and preparation of draft Code revisions shall be completed by April 1st. The Central Committee may at this stage add any amendments, designating the source of such amendments, and shall be responsible for co-ordinating them in any other sections of the Code, as it may in their estimation be deemed necessary.

April 1st—

- (c) **Provincial Committees (Consideration by)**—On or before April 1st the Central Committee shall submit to the Secretary of the C.E.S.A. the first draft revision of the Code. The Secretary shall refer the draft revision to each Provincial Committee for consideration and ballot. A majority vote in a Provincial Committee shall be necessary for the acceptance or rejection by that Committee of the draft revision, or of an alternative or new proposal for any portion of it that may emanate, at this stage, from a Provincial Committee.

May 1st—

- (d) **Central Committee**—The Provincial vote shall be returned on or before May 1st, to the C.E.S.A. Secretary for collation and report to Central Committee.

July 1st—

- (e) **Central Committee—Completion of First Draft**—Consideration of votes by the Central Committee will then follow and an affirmative vote from the majority of the Provincial Committees shall be necessary and sufficient to ensure the inclusion of any proposed revision in

**(Approximately 15 months prior to the anticipated date of publication of a revised edition of the Canadian Electrical Code, Part I.)*

the final draft. The Central Committee will then prepare a second draft revision and, also, the agenda for the meeting of the C. E. Code Committee. This draft revision shall be submitted by the Secretary of the C.E.S.A. to the members of the C. E. Code Committee not later than July 1st.

September 1st, (not later than)—

- (f) **Meeting—Committee on C. E. Code, Part I—Approval of Final Draft**—The C. E. Code Committee shall meet not later than September 1st, or as provided in Clause 5, for the purpose of considering the draft revision submitted by the Central Committee. The C. E. Code Committee in its meetings shall follow the Rules of Procedure set forth in Clause 6, below.

September 15th—

- (g) **Central Committee—Editing**—The Revised Code, as approved by the C. E. Code Committee, shall be submitted to the Central Committee for editing on or about September 15th.

December 1st—

- (h) **C.E.S.A. Main Committee—Letter Ballot**—The draft revisions shall be submitted to the C.E.S.A. Main Committee for letter ballot by December 1st.
- (i) **Publication**—Subject to the approval of the C.E.S.A. Main Committee, the new Code will then be published (on, or about, **January 1st**).

5.—Meetings of C. E. Code Committee.

- (a) **Time**—The C. E. Code Committee shall meet between July 1st and September 1st in the year immediately prior to the year of publication of the Code, or at the call of the Chairman or at the signed request of ten members of the Committee.
- (b) **New Material**—At any meeting of the C. E. Code Committee suggested revisions of the Code, or subjects for discussion, not previously dealt with in the procedure set forth in Clause 4, may be introduced only by the unanimous consent of those present.

6.—Meetings of the C. E. Code Committee— Rules of Procedure for

- (a) **Quorum**—An attendance of not less than two-thirds of the total membership of the C. E. Code Committee, the Central Committee, or of a Provincial Committee, shall be necessary to constitute a quorum. If at least one-third of the entire membership of any committee be present at any regularly-called meeting, decisions may be made regarding Code changes, but each item shall be subject to the approval of the committee by letter ballot, in which case a two-thirds affirmative vote of the total membership of the Committee is necessary for adoption. At a regularly-called meeting of the C. E. Code Committee, changes in or additions to the Code may be made only with the approval of two-thirds of the members present and voting.
- (b) **Proxies**—Voting by proxy will be permitted provided that written notice relative to the proxy has been filed with the Chairman prior to the meeting.
- (c) **Alternates**—A member of any of the Committees herein-before mentioned may, with the approval of the Chairman, be represented at any meeting of his Committee by an alternate who may attend the meeting, and in the absence of the member, vote in his stead.
- (d) **Sub-committees** — Committees may create sub-committees or conference committees for specific purposes, and may add thereto representatives of co-operating organizations or qualified specialists from outside the membership of the parent committee. Such sub-committee members shall not have voting power in the committees.

7.—Meetings of Central and Provincial Committees.

Meetings of the Central Committee or the Provincial Committees shall be called by the Chairmen of the respective committees. At least one week's notice in writing of such meetings shall be given, except by unanimous consent of the members.

8.—Interim Revision—Canadian Electrical Code Part I—Procedure for

This procedure is set up to provide for action relative to suggested revisions urgently requested, and requiring decisions which cannot be deferred until the next regularly-called meeting of the C.E. Code Committee.

-
- (a) Applications for revision of the Code may be submitted to the Secretary of the Canadian Engineering Standards Association at any time. The specific wording desired shall be stated in the application.
 - (b) The request shall be submitted to the Central Committee, which, after discussion, must, within 60 days, recommend for or against further consideration. The Central Committee may request the applicant to obtain a fact-finding report from a recognized laboratory.
 - (c) If the recommendation is for further consideration, the Secretary of the Canadian Engineering Standards Association shall submit to the Provincial Committees a letter ballot, together with information prepared by the Central Committee. If affirmative votes be received from seven Provincial Committees, the Secretary of the Canadian Engineering Standards Association shall then submit the proposed revision to the C. E. Code Committee for letter ballot. If an affirmative vote of at least two-thirds of the total membership of the C. E. Code Committee be received, the revision shall be adopted as a tentative interim revision. If after 60 days from the date of distribution ballots have not been received from the Provincial Committees or the C. E. Code Committee, they shall be considered as being in the affirmative.
 - (d) Such interim revisions shall be submitted for confirmation under established procedure at the next regularly-called meeting of the C. E. Code Committee.
 - (e) If the recommendation of the Central Committee be against further consideration of the application, an appeal endorsed by six sustaining members of the C.E.S.A., of whom the applicant shall be one, may be made to the C. E. Code Committee. The Secretary of the C.E.S.A. shall submit a letter ballot to the C. E. Code Committee, together with information submitted by the applicant and the report of the Central Committee. If an affirmative vote of at least two-thirds of the total membership of the C. E. Code Committee be received, the suggested revision shall be adopted as a tentative interim revision and thereafter dealt with as under paragraph (d) above.
 - (f) If the affirmative votes referred to in (e) above be less than two-thirds of the total membership of the C. E. Code Committee, the proposed revision shall be declared lost, and the Secretary of the C.E.S.A. shall so inform the applicant.

- (g) If any application for revision, or appeal, be rejected, the applicant may again apply for revision after a lapse of six months.
- (h) Interim revisions shall be published every six months.

9.—Canadian Electrical Code, Part I
Interpretation of

- (a) Requests for interpretation shall be made in writing to the Secretary of the C.E.S.A.
- (b) The Secretary shall refer these requests to the Central Committee, which shall report within 30 days.
- (c) The Secretary shall inform the enquirer of the findings of the Central Committee.
- (d) Interpretations shall be published by the C. E. S. A. every six months.

APPENDIX C

COMMITTEE ON CANADIAN ELECTRICAL CODE

PART II

(Approvals Specifications)

ORGANIZATION AND RULES OF PROCEDURE

1.—General

The **Committee on C. E. Code, Part II** has succeeded to the duties of the former **C.E.S.A. Panel on Specifications** in the preparation of specifications governing the approval, for use in Canada, of electrical appliances and equipment.

(The **Committee on C. E. Code, Part II** is referred to hereafter throughout this Appendix as "**the Committee.**")

2.—Authorization

Authority for the organization of the Committee, for nominations and appointments of its members, for the scope of work of the Committee and for general rules of procedure, was formally granted by the Committee on C. E. Code, Part I (*to which the Committee is subsidiary*) and by the C.E.S.A. Executive Committee on November 25, 1938. Details of organization and rules of procedure for the Committee on Canadian Electrical Code, Part II are as follows:—

3.—Organization

- (a) **Composition**—The Committee shall be composed of eleven members who shall be nominated by the organizations named below:—

Chairman (from the Approvals Laboratory)	1
Canadian Electrical Association	1
Canadian Underwriters' Association	1
Inspection Authorities	1
National Research Council	1
Approvals Laboratory	1
Electrical Manufacturers	5

 11

- (b) **Nominations** of members shall be submitted to the Executive Committee of the Canadian Engineering Standards Association for approval and formal appointment to membership in the Committee.

4.—Rules of Procedure

- (a) **Place and Notice of Meetings**—Meetings, generally, shall be called in February, May and November, alternately in Toronto and Montreal, or at other times and in such places as the Chairman may deem advisable. Notice of meetings shall be sent out two weeks in advance of the date set for the calling of meetings of the Committee or of any of its sub-committees, and shall be accompanied by an agenda indicating the points which are scheduled for discussion.
- (b) **Quorum**—An attendance of not less than two-thirds (8 members, as at present constituted) of the Committee shall be necessary to constitute a quorum. If at least one-third of the entire membership be present at any regularly called meeting, decisions may be made relative to specifications scheduled for discussion, but each item shall be subject to the approval of the Committee by letter ballot.
- (c) **Alternates**—Provided that written notice from the member is presented at the meeting, a member may be represented at any meeting by an alternate who may attend, and in the absence of the member, vote in his stead.
- (d) **Proxy**—Voting by proxy will be permitted provided that written notice relative to the proxy be filed with the Chairman prior to the meeting.
- (e) **Appointment of Sub-Committees**—The Committee may appoint sub-committees or conference committees for specific purposes and may add thereto representatives of co-operating organizations or qualified specialists from outside the membership of the parent committee. Co-opted members may attend meetings of the Committee but shall have no voting power.
- (f) **Composition of Sub-committees** — Each sub-committee shall consist of a chairman, who shall be a member of the Committee and be appointed by the Committee, and a representative of the Approvals Laboratory, with power to add to their numbers, as may be required, subject to the approval of the Chairman of the Committee. The Laboratory representative shall be the secretary of the sub-committee.

- (g) **Publicity—re Appointment of Sub-committees**—On the appointment of a sub-committee, all interested parties should be circularized or notified through the technical press (by the C.E.S.A. Secretary) that —
- (1) a sub-committee on the subject has been formed, naming the Chairman;
 - (2) comments are invited from all interests, relative to points which should be scheduled for discussion.
- (h) **Disbandment of Sub-committees**—Upon the completion and publication of any specification or revision thereof, the sub-committee which has prepared or revised it shall be disbanded.
- (i) **Preparation of Specifications**—Procedure for preparation of specifications shall be as outlined in Clause 5 of this Appendix.
- (j) **Voting on Specifications**—Specifications of which the approval of the Committee is desired, shall be submitted at regular meetings of the Committee, or, at the discretion of the Chairman, may be approved by letter ballot. Approval of specifications shall not be given at meetings of the Committee unless due notice that such a decision is scheduled be given at the time of calling the meeting.
- If specifications be presented for approval of the Committee at an authorized meeting, when a quorum is present, approval of specifications so presented shall be established on an affirmative vote of two-thirds of those present who are qualified to vote.
- If specifications or revisions thereto be submitted to the Committee for approval by letter ballot and the affirmative votes be at least two-thirds of the total membership of the Committee, the specifications or revisions shall be submitted to the Committee on Part I for approval by letter ballot.
- If the affirmative votes be at least two-thirds of the total membership of the Committee on C.E. Code Part I, the specification or revision shall be submitted to the C.E.S.A. Main Committee for approval and authority to publish as a C.E.S.A. standard.
- If after 30 days from the date of distribution, ballots have not been returned by any members of sub-committees or of the Committee, as the case may be, it shall be considered that those members have voted in the affirmative.

5.—Procedure in Establishment of Specifications

(C. E. Code, Part II).

- (a) Priority of requests for specifications shall be decided upon at the meeting of the Committee next subsequent to the date of receipt of such requests. Any interest making a request for the establishment of a specification shall submit a draft specification, if possible.
- (b) An appropriate sub-committee shall be appointed (see Clause 4(e)) to prepare a "preliminary"* draft and to discuss its contents.
 - (i) A "preliminary"* draft shall be distributed to members of the sub-committee by its Secretary and to all manufacturers of the equipment covered by the draft, who are listed in the active Approvals records and to all members of the Committee. Comments on this "preliminary" draft are to be sent to the **Secretary of the sub-committee** within 30 days.
 - (ii) If these comments are of such a minor nature that the Chairman and Secretary of the sub-committee believe they could be incorporated in the first "**C.E.S.A.**"* draft and there is, therefore, no need for calling a conference of the manufacturers to discuss them, the revised "**preliminary**" draft will then be given the C.E.S.A. "C22.2" designation and a serial number, as the first "**C.E.S.A.**" draft of this specification.
 - (iii) If, however, the comments are such as to indicate a divergence of opinion, these comments shall be referred, by letter, to members of the sub-committee, and to the interested manufacturers, by the Secretary of the sub-committee, or, if necessary, by the calling of a conference to discuss them. After this, a second "preliminary" draft shall be prepared and circulated as in Clause 4 (b) (i). This second "**preliminary**" draft, if satisfactory, shall then become the first "**C.E.S.A.**" draft as noted above. This process shall be repeated until a draft, satisfactory to a majority of interests, is obtained.

**Note: In sub-committee stage, draft specifications will be referred to as "first, second, etc. 'Preliminary' draft", and, in committee stage, as "first, second, etc. 'C.E.S.A.' draft."*

-
- (c) The first "C.E.S.A." draft shall then be circulated to all interests by the C.E.S.A. Secretary.
 - (d) Comments on all "C.E.S.A." drafts shall be submitted to all interests **through the C.E.S.A. office.**
 - (e) A general conference of interests may be called, if deemed necessary.
 - (f) The final "C.E.S.A." draft shall be edited by the editor appointed by the Committee, prior to presentation to the Committee.
 - (g) The final "C.E.S.A." edited draft shall be presented, to a meeting of, or for letter ballot to, the Committee.

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SUSTAINING MEMBERS, 1938

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 Algoma Steel Corporation Ltd.
 Aluminum Company of Canada, Ltd.
 Amalgamated Electric Corporation, Ltd.
 *Anglo-Canadian Wire Rope Co. Ltd.
 *Asbestos Corporation Ltd.
 *Atlas Construction Co. Ltd.
 *Bakelite Corporation of Canada
 Bell Telephone Company of Canada
 *Bepco Canada Ltd.
 Bertram & Sons Co. Ltd., John
 *Boiler Inspection & Insurance Co. of Canada
 Boston Insulated Wire & Cable Co. Ltd.
 British Columbia Electric Railway Co.
 B.C. Lumber & Shingle Manufacturers Association
 British Columbia Telephone Company
 Burlington Steel Co. Ltd.
 *Byers & Co. Ltd., A. F.
 Cables, Conduits & Fittings Ltd.
 Canada Cement Company, Ltd.
 Canada Creosoting Company, Ltd.
 Canada Iron Foundries, Ltd.
 Canada Wire & Cable Co. Ltd.
 Canadian Acme Screw & Gear, Ltd.
 Canadian Bridge Company, Ltd.
 *Canadian Controllers, Ltd.
 Canadian General Electric Co. Ltd.
 Canadian Industries Limited
 Canadian Ingersoll-Rand Co. Ltd.
 *Canadian Institute of Steel Construction
 Canadian Laco Lamps, Limited
 Canadian Jefferson Electric Co. Ltd.
 Canadian Liquid Air Co. Ltd.
 Canadian Lumbermen's Association
 *Canadian Marconi Company
 Canadian National Railways
 Canadian Pacific Railway Company
 Canadian Triangle Conduit Co. Ltd.
 Canadian Tube & Steel Products Ltd.
 *Canadian Western Natural Gas, Light Heat & Power Co. Ltd.
 Canadian Westinghouse Co. Ltd.
 Coghlin Co. Ltd., B. J.
 Consolidated Mining & Smelting Co. of Canada, Ltd.
 *Consolidated Red Cedar Shingle Association of B.C.
 *Conduits National Company, Ltd.
 Council of Canadian Purchasing Agents Associations
 Crane Limited
 Crouse-Hinds Company of Canada, Ltd.
 *Dansereau Limitée
 Dome Mines, Limited
 Dominion Bridge Company, Ltd.
 Dominion Chain Company, Ltd.
 Dominion Engineering Works, Ltd.
 Dominion Foundries & Steel, Ltd.
 Dominion Oxygen Company, Ltd.
 Dominion Steel & Coal Corporation, Ltd.
 *Dominion Wire Rope & Cable Company, Ltd.
 *Donald Ropes & Wire Cloth Company
 *Drummond McCall & Co. Ltd.
 *East Kootenay Power Company, Ltd.
 Eaton Company, Ltd., T.
 English Electric Co. of Canada, Ltd.

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- Federal Wire & Cable Co. Ltd.
 Ferranti Electric Limited
 Foundation Company of Canada, Ltd.
 *Fraser Companies Limited
 *Frigidaire Division, General Motor Sales Corporation
 Frost Steel & Wire Company, Ltd.
 Gatineau Power Company
 Hamilton Bridge Company, Ltd.
 Hoover Company Ltd.
 *Hydro-Electric Power Commission of Ontario
 Imperial Oil, Ltd.
 International Nickel Co. of Canada, Ltd.
 *Janin & Company, Limited, A.
 *Leland Electric, Canada, Ltd.
 *Linde Canadian Refrigeration Co. Ltd.
 *Link-Belt Limited
 *Manitoba Power Commission
 *Maritime Electric Co. Ltd.
 Maritime Telegraph & Telephone Co. Ltd.
 Massey-Harris Company, Ltd.
 McKinnon Columbus Chain, Ltd.
 Moloney Electric Company of Canada, Ltd.
 Montreal Light, Heat & Power Consolidated
 Montreal Locomotive Works, Ltd.
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 *National Sewer Pipe Company Ltd.
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 New Brunswick Telephone Co. Ltd.
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 Otis-Fensom Elevator Company, Ltd.
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 *Saguenay Power Co. Ltd.
 *Sarnia Bridge Co. Ltd.
 St. Mary's Cement Co. Ltd.
 Sangamo Company Limited
 Saskatchewan Government Telephone System
 *Shawinigan Water & Power Company
 *Simpson Co. Ltd., Robert
 Slater Company, Ltd., N.
 Smith & Stone, Limited
 Solex Company, Ltd.
 Square D Company, Canada, Limited
 Steel Company of Canada, Ltd.
 Swiss Electric Company of Canada, Ltd.
 Stowell Screw Co. Limited
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 Wagner Electric Mfg. Co. Ltd.
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